

*Shelve in Stacks S.B.T.*

71-16

# Highway Safety Literature

An Announcement  
of Recent Acquisitions. . .

HSL No. 71-16  
May 21, 1971



**THIS ISSUE CONTAINS:**

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U.S. Department of Transportation / National Highway Traffic Safety Administration

HSL No. 71-16 May 21, 1971 HS-008 933—HS-009 012, HS-800 283-284, HS-800 374-375:  
HS-800 393-394, HS-800 400-402, & 405, HS-800 422-427, HS-800 459 & 464

# HIGHWAY SAFETY LITERATURE

## AN ANNOUNCEMENT OF RECENT ACQUISITIONS

Published Bi-Weekly (26 times a year) by the National Highway Traffic Safety Administration

Washington, D. C. 20591

### INTRODUCTION

Publications announced in *Highway Safety Literature* include the most recent additions to the collection of the NHTSA Scientific & Technical Information Service. Subject areas covered include all phases of highway, motor vehicle, and traffic safety, especially those encompassed by the National Traffic and Motor Vehicle Safety Act of 1966 and the Highway Safety Act of 1966.

Individual issues of *HSL* are numbered according to the year and the issue number within that year; thus, 71 designates the year and 1, 2, 3, etc. the individual issues. To aid the user in location citations by the HS-number, the cover bears the inclusive entry numbers for each issue.

Entries in *HSL* are arranged according to the revised NHTSA Subject Category List shown in the Table of Contents. The List is a two-level arrangement consisting of five major subject fields subdivided into 58 subject groups. Documents related directly to the National Highway Traffic Safety

Administration (NHTSA) are announced in a separate section headed NHTSA DOCUMENTS and are numbered in five distinct series: NHTSA Accident Investigation Reports (HS-600 000 series), NHTSA Compliance Test Reports (HS-610 000 series), NHTSA Contractors Reports (HS-800 000 series), NHTSA Staff Speeches, Papers, etc. (HS-810 000 series), and NHTSA Imprints (HS-820 000 series). For NHTSA DOCUMENTS in series HS-600 000 and HS-610 000, individual full case reports are available for inspection at the National Highway Traffic Safety Administration; or for purchase from NTIS (see page ii). Although announced together in a separate section, these documents are also assigned specific subject categories for machine retrieval.

A document which contains a number of separate articles is announced as a complete volume in the subject category most applicable to it as a whole. Entries for the individual articles appear in their most specific subject category.

### SAMPLE ENTRIES

#### Subject Category Array

NHSB Accession no..... HS-800 218 Fld. 5/21; 5/9  
Title of document..... AN INVESTIGATION OF USED CAR SAFETY STANDARDS-SAFETY INDEX: FINAL REPORT. VOL. 6 - APPENDICES G-L

Personal author(s)..... by E. N. Wells; J. P. Fitzmaurice; C. E. Williams; S. R. Kalin; P. D. Williams

Corporate author..... Operations Research, Inc., Silver Spring, Md., 0150000

#### Collation

Publication date..... 12 Sep 1969 150p  
Contract FH-11-6921  
Report no. ORI-TR-553-Vol-6; PB-190 523

Abstract..... Appendices G-L to this study of used car safety standards include: indenture model diagrams for classes I-IV motor trucks; degradation, wear, and failure data for motor truck classes I-IV; and safety index tables for classes I-IV motor trucks.

Search terms: Wear /Trucks;  
Failures /Trucks; Used cars; Inspection standards /Trucks; Inspection standards /Data

AVAILABILITY: NTIS

HS-004 497 Fld. 5/19

#### AUTO THEFT-THE PROBLEM AND THE CHALLENGE

by Thomas A. Williams, Sr.

Journal citation . . . Published in *FBI Law Enforcement Bulletin* v37 n12 p15-7 (Dec 1968)

Gives figures on the extent of the auto theft problem and comments on anti-theft devices available now or in the planning stage.

Search terms: Theft, Theft protection, Stolen cars

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NOTE: Material published in Highway Safety Literature (HSL) is intended for the information and assistance of the motor vehicle and highway safety community. While brands names, equipment model names and identification, and companies may be mentioned from time to time, this data is included as an information service. Inclusion of this information in the HSL should not, under any circumstances, be construed as an endorsement or an approval by the U. S. Department of Transportation, National Highway Traffic Safety Administration of any particular product, course, or equipment.

Harry A. Feinberg  
Managing Editor

**AVAILABILITY OF DOCUMENTS  
AND  
INSTRUCTIONS FOR ORDERING**

Department of Transportation personnel may borrow copies of publications directly from the NHTSA. Outside the Washington, D.C. area, phone (202) 426-2768. In Washington, D.C. area, use government ID, phone 118-62768. Non-DOT personnel should contact their company or agency libraries for assistance.

Journals cited may be obtained through most research libraries.

Contractors' reports and other documents can usually be obtained as indicated under AVAILABILITY. However, there is no certainty that retention copies will be available for more than a limited period after a document is issued.

The more common distribution sources are identified by symbols which are explained below:

**NTIS:** National Technical Information Service (formerly Clearinghouse for Federal Scientific and Technical Information-CFSTI), Springfield, Va. 22151. Order by accession number: *HS*, *AD*, or *PB*. Prepayment is required by NTIS (CFSTI) coupon (GPO coupons are not acceptable), check, or money order (made payable to the NTIS). *HC* (Paper copy; full size original or reduced

facsimile) \$3.00 up; *MF* (microfiche approximately 4x6" negative sheet film; reader required) \$0.95.

**GPO:** Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Give corporate author, title, personal author, and report number. Prepayment is required by GPO coupon (NTIS [CFSTI] coupons are not acceptable), check or money order (made payable to the Superintendent of Documents).

**HRB:** Highway Research Board, National Academy of Sciences, 2101 Constitution Ave., N. W., Washington, D. C. 20418.

**NHTSA:** National Highway Traffic Safety Administration General Services Division, Washington, D.C. 20591 (Telephone (202) 426-0874).

**SAE:** Society of Automotive Engineers, Dept. HSL, 2 Pennsylvania Plaza, New York, N.Y. 10001. Order by SAE report number. Prices given are list; discounts are available to members and sometimes to libraries and U.S. Government Agencies. Prepayment is required; orders without payment are subject to a \$1 handling charge.

**IMPORTANT**

**WHEN REQUESTING** a document, to be absolutely sure you receive what you order, give the accession number (*HS*, *PB*, *AD* number) or report number (in cases such as an SAE document), title of report, and the personal or corporate author (whichever is cited). When requesting an *HS*-numbered document from NTIS (CFSTI), add DOT/ to the prefix *HS*-, example *HS*-800 000 should be ordered as DOT/*HS*-800 000.

MAY 21, 1971

## ACCIDENTS

MAY 21, 1971

### 1/0 ACCIDENTS

#### 1/2 Injuries

HS-008 933 Fld. 1/2; 5/7

**CRITICAL EVALUATION OF ASSESSMENT METHODS FOR HEAD IMPACT APPLIED IN APPRAISAL OF BRAIN INJURY HAZARD, IN PARTICULAR IN HEAD IMPACT ON WINDSHIELDS (KRITISCHE BETRACHTUNG DER BEWERTUNGSVERFAHREN VON STOSSEN GEGEN DEN MENSCHLICHEN KOPF DIE ZUR BEURTEILUNG DER GEFAHR EINER HIRNVERLETZUNG, INSBESONDERE BEIM AUFPRALL DES KOPFES GEGEN DIE WINDSCHUTZ-SCHEIBE, ANWENDUNG FINDEN**

by A. Slattenschek; W. Tauffkirchen

Technische Hochschule in Wien (Austria), T08000

Published in 1970 *International Automobile Safety Conference Compendium* (P-30), New York, 1970, p1084-112.

9 refs

Report no. SAE-700426

Text also in German. Includes summary in French. Presented at 1970 International Automobile Safety Conference: Detroit, Mich., 13-15 May 1970, Brussels, Belgium, 8-11 Jun 1970.

For assessment of the hazard of head impact on a windshield, two impact assessment methods are known, based on diametrically opposed concepts concerning the cerebral injury process. The method of C. W. Gadd (Gadd's hypothesis) and of the Vienna Institute of Technology (Vienna hypothesis) are discussed. The respective assessment values of the two methods are Severity Index S and Tolerance Value J. Both methods relate assessment of an impact to the so-called Wayne State curve. The methods are examined as to their deviations from this curve and as to comparability of results. It appears that Tolerance

Value J results in better reproducibility of the Wayne State Curve and that the values of Severity Index S must undergo correction.

Search terms: Impact tolerances/Statistical analysis; Head injuries/Windshields; Brain injuries/Windshields; Injury severity index; Injury research/Statistical analysis

AVAILABILITY: SAE; also in HS-007 859

#### 1/3 Investigation and Records

HS-008 934 Fld. 1/3

**ACCIDENT FACTS, NEW YORK STATE, 1970. AN ILLUSTRATED ANALYSIS OF 1969 ACCIDENT RECORDS**

New York (State). Dept. of Motor Vehicles, Albany, N51000

1970 41p

Accident statistics include: reportable motor vehicle accidents from 1930 through 1969; a 20-year summary; death and injury rates; injury seriousness; data by county; age distribution of the killed and injured; type of accident; driver age and sex data; pedestrian age data; directional diagrams for both pedestrians and vehicles; hour of day and day of week; environmental factors; traffic control; road conditions; and statistical tables.

Search terms: Accident statistics/New York (State); Accident records/Accident analysis; Fatality rates/New York (State); Injury rates/New York (State); Injury severity/Accident statistics; Age factor in accidents/Accident statistics; Accident types/Accident statistics; Driver age/Accident statistics; Driver sex/Accident statistics; Pedestrian accidents/Accident statistics; Environmental factors/Accident statistics; Traffic control/Accident statistics; Road conditions/Accident statistics; Time of day/Accident statistics; Day of week/Accident statistics

HS-008 935 Fld. 1/3

**TRAFFIC COLLISIONS IN NORTH CAROLINA. 1969 ANNUAL STATISTICAL SUMMARY**

North Carolina. Dept. of Motor Vehicles, Raleigh. Driver Education and Accident Records Div., N63000

1970 27p

Aspects covered in these accident statistics include: analysis of rural and urban accidents; causes, location, and time of fatal accidents; age of driver and pedestrian fatalities; types of accidents; pedestrian accidents; environmental factors; accidents by cities, towns, and counties.

Search terms: Accident statistics/North Carolina; Rural accidents/North Carolina; Urban accidents/North Carolina; Accident causes/Accident statistics; Accident location/Accident statistics; Fatalities/Accident statistics; Pedestrian accidents/Accident statistics; Environmental factors/Accident statistics; Driver age/Accident statistics; Accident types/Accident statistics; Time factors/Accident statistics; Pedestrian age/Accident statistics

HS-008 936 Fld. 1/3.

**COMPACT CAR ACCIDENT STUDY. GARDEN STATE PARKWAY**

New Jersey. Highway Authority, Woodbridge, N41700

1969 30p

The general picture of a compact car is that it does not get into more than its share of accidents, but does inflict proportionately more injuries on its riders; it is involved in more single-vehicle accidents, it runs off the road more, it has a greater tendency to overturn, and it is operated by relatively young drivers. The results of the present study do not substantially alter the above, but suggest that the differences between standard and compact cars may be gradually lessening. Whether this is a situation that is

### 1/3 Investigation and Records (Cont'd.)

#### HS-008 936 (Cont'd.)

peculiar to the Parkway or indicative of a general trend is uncertain. It may be that the recent emphasis on safety is having some effect on accident and injury trends. Whatever the case, it is likely that additional safety requirements of the Federal government will produce changes in automobiles in the early 1970's. Recognition by the American Auto industry of a sizable market for small, economical cars through its introduction of several new cars in this category should also become noticeable toward the end of 1970.

Search terms: Compact automobile accidents /Statistics; Vehicle size /Accident statistics; Compact automobile accidents /Injury statistics; Single vehicle accidents /Compact automobiles; Compact automobile accidents /Fatalities; Volkswagens /Accident statistics; Rollover accidents /Compact automobiles; Ran off road accidents /Compact automobiles

#### HS-008 937 Fld. 1/3

### POTENTIAL HEAD AND NECK INJURY FROM WINDSHIELD IMPACTS

by L. M. Patrick

Wayne State Univ., Detroit, Mich. Dept. of Engineering Mechanics, W11400

Published in *Conference on Road Safety*. Vol. 2, Brussels, 1968, pA10-1 to A10-22

6 refs

A series of dummy and cadaver experiments was conducted to establish whether neck and head injuries would be expected with the 30 mil HPR windshield installation. Tests were made with no restraint, rubber gasket,

and bonded installation using a butyl tape. Head injuries from impacting the cowl were observed with the unrestrained and extruded rubber gasket installations. The accelerations measured on the back of the head in an A-P direction were below the brain damage level as interpreted by the WSU tolerance curve and the injury index for the first and second acceleration peaks. No bending or compression injuries to the cervical spine were observed by radiological examination or palpation.

Search terms: Cadavers /Impact tests; Cadavers in testing; Dummies /Impact tests; Windshields /Head injuries; Windshields /Neck injuries; Windshields /Injury severity index; Impact velocity /Windshields

#### HS-008 938 Fld. 1/3

### AUTOMOBILE COLLISION AND THE EFFECT OF THE NEW U. S. A. STANDARDS

by A. W. Siegel; A. M. Nahum

California Univ., Los Angeles, C18600

Published in *Conference on Road Safety*. Vol. 2, Brussels, A15-1 to A15-80

23 refs

The evolution of collision injury safety in modern American automobiles is traced. The effectiveness of several standards is described and collision examples are given where current performance standards are under study. Conclusions of detailed accident studies by medical-engineering teams are presented. A Trauma Research Group at the University of California, Los Angeles, has been involved in live accident studies for the past several years. Results illustrating reduced injury levels due to improved steering wheel column systems, improved windshields, and load distributing panels and the need for improved side impact protection are documented. In addition, cases are presented which illustrate other areas of needed design change where current performance standards are being developed:

truck-trailer underride protection, seat anchorage failure, fuel tank rupture, hood latch failure, and windscreen-pillar failure. The need for adequate child restraint systems is discussed.

Search terms: Safety standards /Injury prevention; Accident investigation /Multidisciplinary teams; Accident case reports; Impact velocity /Injury severity index; Steering wheel caused injuries; Instrument panel caused injuries; Door caused injuries; A pillars /Injury causes; Header caused injuries; Floors /Injuries; Window caused injuries; Seat caused injuries; Mirror caused injuries; B pillars /Injuries

#### HS-008 939 Fld. 1/3; 1/2

### MOTORCYCLES: RANDOM PARTICLES IN THE TRAFFIC STREAM

by Thomas L. McDole

Published in *HIT Lab Reports* p1-8 (Dec 1970)

A study was made of 557 fatal accidents in Michigan in which a motorcycle was one of the vehicles involved. The study covered six years and showed that 74.5% of the accidents took place during the summer, between May 15 and Sept. 15. Involvement in fatal motorcycle accidents is clearly a young person's problem, 89.2% of the operators being under age 35. Age group tables, time of day, type of accident, location by county, and comparison of motorcycle registrations with fatal motorcycle accidents are given.

Search terms: Motorcycle accidents /Accident analysis; Motorcycle accidents /Fatalities; Motorcycle accidents /Time of day; Motorcycle accidents /Accident types; Motorcycle registration /Accident rates; Age factor in accidents /Motorcycle accidents; Young adult drivers /Motorcycle accidents; Summer /Accident rates

HS-008 940 Fld. 1/3; 3/4; 3/1; 2/8

**PORTRAIT OF A YEAR. 1969. THE DRINKING DRIVER. THE PROBLEM DRIVER. THE YOUNG DRIVER. BRING 'EM BACK ALIVE!**

Automobile Club of Michigan, Detroit, A79200

Mar 1970 54p

During 1969, there were 2,481 deaths on Michigan roads. Over the four weekends studied there were 130 persons killed. The report discusses the following six areas; alcohol, problem drivers, young drivers, law enforcement, traffic engineering, and snowmobiles.

Search terms: Snowmobiles/Wisconsin; Traffic engineering/Wisconsin; Traffic law enforcement/Fatalities; Adolescent drivers/Fatalities; Young adult drivers/Fatalities; Problem drivers/Fatalities; Drinking drivers/Fatalities

HS-008 941 Fld. 1/3; 4/7

**ON THE ANALYSIS OF ACCIDENT TRENDS**

by Wolfgang S. Homburger

Published in *Accident Analysis and Prevention* v1 p101-4 (1969)

5 refs

The need to convert raw accident statistics to some form of accident rate is emphasized. Three rates are discussed: occurrence, involvement, and injury severity. Methodology is illustrated by converting accident statistics to rates. This sample calls attention to trends which justify the current concern with placing fixed objects near the roadway and with the design of breakaway sign and light supports. The effectiveness of the safety efforts directed toward pedestrians generally is justified, but it is shown that it is not helping children and young adults as much as those aged 25 and over. By means of a severity rate, it can be shown that motor vehicle collisions with trains are still by far the most lethal type of accident. The ur-

ban-rural analysis reminds us that pedestrian accidents still account for one-third of all the urban fatalities, while running off the roadway occurs more frequently than any other type of rural fatal accident.

Search terms: Accident rates; Accident statistics; Fixed objects/Accident rates; Breakaway structures/Accident rates; Pedestrians/Accident rates; Railroad grade crossing accidents/Statistics; Ran off road accidents/Statistics; Injury severity/Accident rates; Accident analysis

HS-008 942 Fld. 1/3

**WHAT WE'RE TALKING ABOUT**

by William Haddon, Jr.

Insurance Inst. for Highway Safety, Washington, D. C., I36000

Published in *Key Issues in Highway Loss Reduction*, Washington, 1970, p7-22

Presented at Insurance Institute for Highway Safety 1970 Symposium, Washington, D. C., 9-10 Jun 1970.

The environmental hazards pertaining to highway safety are discussed in terms of the precrash phase, crash phase, and postcrash phase. Accident prevention alone is not an adequate approach to the problem. Characteristics of the vehicles can be improved to make injuries less severe. Examples discussed are improved windshields, energy absorbing steering columns, and helmets for motorcycle operators.

Search terms: Highway safety/Environmental factors; Precrash phase; Crash phase; Postcrash phase; Accident prevention; Injury severity/Automobile design; Helmets/Motorcycle safety; Windshield design; Energy absorbing steering columns

AVAILABILITY: In HS-008 943

**2/0 HIGHWAY SAFETY**

HS-008 943 Fld. 2/0

**KEY ISSUES IN HIGHWAY LOSS REDUCTION. PROCEEDINGS OF THE INSURANCE INSTITUTE FOR HIGHWAY SAFETY 1970 SYMPOSIUM, WASHINGTON, D. C., JUNE 9-10, 1970**

by Charles W. Wixon, ed.

Insurance Inst. for Highway Safety, Washington, D. C., I36000

1970 307p

This conference on highway safety deals with the problem from a number of viewpoints. Aspects emphasized are the drinking driver problem and the use of pre-arrest breath tests; roadside hazards and their improvement; crashworthiness; crash tests and repair costs; priorities in highway safety;

Search terms: Highway safety/Priorities; Highway safety/Conferences; Alcohol breath tests/Arrests; Drinking drivers/Alcohol usage deterrents; Roadside hazards; Highway improvements; Crashworthiness/Automobile design; Impact tests/Automobile repair costs

AVAILABILITY: Corporate author

HS-008 944 Fld. 2/0

**ADDRESS**

by John A. Volpe

Department of Transportation, Washington, D. C., D17400

Published in *Key Issues in Highway Loss Reduction*, Washington, 1970, p71-8

Presented at Insurance Institute for Highway Safety 1970 Symposium, Washington, D. C., 9-10 Jun 1970.

Progress in solving the highway safety problem is discussed. Examples discussed are occupant restraint systems, better designed cars, control of alcoholic drivers, and improvement in automobile insurance.

**2/0 Highway Safety (Cont'd.)****HS-008 944 (Cont'd.)**

Search terms: Highway safety; Restraint systems; Occupant protection; Alcohol usage deterrents; Automobile design/Safety design; Alcoholism/Accident factors; Insurance industry

AVAILABILITY: In HS-008 943

**HS-008 945 Fld. 2/0****RATIONAL PREPARATION OF DECISIONS CONCERNING ROAD SAFETY**

by M. Baudouin; C. Berlioz; M. Ternier

Organisme National de Securite Routiere (France), O20200

Published in *1970 International Automobile Safety Conference Compendium* (P-30), New York, 1970, p21-7

Report no. SAE-700353

Includes summaries in French and German. Presented at 1970 International Automobile Safety Conference: Detroit, Mich., 13-15 May 1970, Brussels, Belgium, 8-11 Jun 1970.

The first phase of a study on planning, programming, and budgeting for highway safety in France is described. Specialists from different disciplines have studied all aspects of the problem and attempted to assign priorities. The conclusions will guide budgetary choices and administrative decisions.

Search terms: Highway safety/France; Priorities/Highway safety; Benefit cost analysis/Highway safety; Accident prevention/France

AVAILABILITY: SAE; also in HS-007 859

**HS-008 946 Fld. 2/0****PROGRESS REPORT ON ROAD SAFETY PILOT STUDY**

by R. Brenner

Department of Transportation, Washington, D. C., D17400

1970 20p

Presented at CCMS Plenary Session, Brussels, 19-20 Oct 1970.

Highway safety topics discussed include: passive restraints, including air bags and a belt system; accident investigation; experimental safety vehicles; international cooperation among governments and the automotive industry.

Search terms: Highway safety/International factors; Government industry cooperation/International factors; Automotive industry/International factors; Air bag restraint systems; Passive restraint systems; Accident investigation; Safety cars; Experimental vehicles; Safety belts/Passive restraint systems

**HS-008 947 Fld. 2/0; 3/0; 4/0;****HIGHWAY SAFETY RESEARCH... A SYMPOSIUM: PROCEEDINGS OF THE REGIONAL HIGHWAY SAFETY RESEARCH SYMPOSIUM HELD AT IOWA CITY, IOWA. MARCH 13, 1969**

by Bertram S. Brown; Edward F. Kearney; William F. Sueppel; Walter A. Cutter; William E. Corgill; John T. Holloway

Iowa Univ., Iowa City, I48600

1969 67p

Includes six untitled speeches.

Dr. Brown pointed out the general lack of knowledge about human behavior and this effect on the actions of drivers, pedestrians and passengers. Mr. Kearney suggested that attorneys and law students can become active in highway safety research by conducting comparative studies of state laws with the Uniform Vehicle Code. Mr. Sueppel explained that the results of research must be sent to the people who are responsible for administration of highway safety in a form that is understandable and that can be put

into practice. Dr. Cutter emphasized the importance of research which would improve high school driver education, and the need for a continuing evaluative survey of high school driver education programs with particular attention to improving teaching techniques, use of contemporary teaching aids, and a study of the driving experience of satisfactorily completing the course against a similar driving group. Dr. Corgill stated that one of the many topics crying for creditable research effort is the matter of how best to implement worthwhile knowledge aimed at reducing highway accidents. He warned that implementation of technical knowledge involves a "no-man's land" of politics, economics, civil service, and personality conflicts.

Search terms: Safety research/Human factors; Safety research/Legal factors; Safety research/Management; Safety research/Driver education; Safety research/Accident prevention

**HS-008 948 Fld. 2/0; 4/8****DEPARTMENT OF TRANSPORTATION. THIRD ANNUAL REPORT. FISCAL YEAR, 1969**

Department of Transportation, Washington, D. C., D17400

17 Mar 1970 209p

Report of activities is presented in sections representing the Office of the Secretary, U.S. Coast Guard, Federal Aviation Administration, Federal Highway Administration, Federal Railroad Administration, Urban Mass Transportation Administration, and the Saint Lawrence Seaway Development Corporation. A section of the Federal Highway Administration report is devoted to the National Highway Safety Bureau.

Search terms: Department of Transportation/Annual reports; National Highway Safety Bureau/Annual reports; Air transportation; Railroads; Highway transportation; Public transportation; Marine transportation

AVAILABILITY: GPO \$1.00



**2/1 Breakaway Structures**

HS-008 949 Fld. 2/1

**IMPACT TESTING OF LIGHTING POLES AND SIGN SUPPORTS, 1967-1968**

by P. Smith

Ontario. Dept. of Highways, Downsview (Canada), O13200

Mar 1970 32p  
Report no. RR-158

The primary aim of this project was an evaluation of existing types of highway lighting poles and sign supports and the benefits of new devices in relation to the hazards they present when struck by out-of-control vehicles. The structures tested included concrete poles, base mounted steel and aluminum breakaway poles, directly buried poles and sign supports for dual cantilevered signs. Station wagons weighing about 4,000 pounds were used in the tests. Reference is made to tests performed elsewhere on wooden signs and supports. Photographs of impacts were taken with high speed cameras, deceleration data recorded, and test observations reported. Recommendations are given regarding the use of different types of supports in specific locations.

Search terms: Breakaway light poles / Impact tests; Breakaway structures / Impact tests; Breakaway sign supports / Impact tests; Station wagons / Impact tests; Poles / Roadside hazards; Sign supports / Roadside hazards; Deceleration / Impact tests; High speed photography / Impact tests

HS-008 950 Fld. 2/1; 1/4

**DEFUSING ROADSIDE BOOBY TRAPS**

by Teddy J. Hirsch

Texas A and M Univ., College Station. Texas Transportation Inst., T18000

Published in *Key Issues in Highway Loss Reduction*, Washington, 1970, p105-31

Presented at Insurance Institute for Highway Safety 1970 Symposium, Washington, D. C., 9-10 Jun 1970.

Roadside hazards are discussed. Fixed objects which cannot be removed should be relocated further from the road or should be put on breakaway bases. Such bases can be used on sign supports and light poles. Impact attenuation devices, particularly steel drums, are also discussed.

Search terms: Roadside hazards / Fixed objects; Sign supports / Roadside hazards; Breakaway sign supports; Breakaway light poles; Impact attenuators / Barrels; Roadside hazards / Accident location

AVAILABILITY: In HS-008 943

**2/4 Design and Construction**

HS-008 951 Fld. 2/4; 1/4

**FINDING BOOBY TRAPS AND THEIR PERPETRATORS**

by Andrew R. Hricko

Insurance Inst. for Highway Safety, Washington, D. C., I36000

Published in *Key Issues in Highway Loss Reduction*, Washington, 1970, p133-7

Presented at Insurance Institute for Highway Safety 1970 Symposium, Washington, D. C., 9-10 Jun 1970.

The task of finding roadside hazards is described. The correction of errors in highway design receives a low priority in most states. A program of the insurance industry is attempting to survey roadside hazards. The industry is urging the correction of hazards.

Search terms: Roadside hazards / Surveys; Insurance industry; Highway improvements / Roadside hazards; Highway improvements / Accident location; Highway design / Roadside hazards; Highway improvements / Priorities

AVAILABILITY: In HS-008 943

HS-008 952 Fld. 2/4; 1/4

**ROADSIDE HAZARDS: AN INTRODUCTION**

by Jackson Wong

Insurance Inst. for Highway Safety, Washington, D. C., I36000

Published in *Key Issues in Highway Loss Reduction*, Washington, 1970, p79-104

Presented at Insurance Institute for Highway Safety 1970 Symposium, Washington, D. C., 9-10 Jun 1970.

Roadside hazards play a role in accidents even on the newest highways. Types of hazards discussed include sign supports, bridge features, curbs, drainage structures, lighting fixtures, slopes and other obstructions, gores, and guardrails. Photographs of typical hazards and wrecked vehicles are included.

Search terms: Roadside hazards / Accident factors; Sign supports / Roadside hazards; Bridge design / Roadside hazards; Drainage / Roadside hazards; Curbs / Roadside hazards; Lighting equipment / Roadside hazards; Slopes / Roadside hazards; Guardrail design / Roadside hazards; Fixed objects / Roadside hazards; Accident location / Roadside hazards; Photographs / Roadside hazards; Highway design / Roadside hazards; Highway accident potential / Roadside hazards

AVAILABILITY: In HS-008 943

HS-008 953 Fld. 2/4

**NEW JERSEY TURNPIKE AUTHORITY 1969. 21st ANNUAL REPORT**

New Jersey. Turnpike Authority, New Brunswick, N42600

1970 56p

Aspects of turnpike operations described include: construction, safety, financing of expanded operations, toll collections, improvements to existing facilities, maintenance, and administration.

## HIGHWAY SAFETY

HSL No. 71-16

### 2/4 Design and Construction (Cont'd.)

#### HS-008 953 (Cont'd.)

Search terms: Toll roads /New Jersey; Highway construction /New Jersey; Highway safety /New Jersey; Highway improvements /New Jersey; Highway costs /New Jersey; Highway maintenance /New Jersey; Highway administration /New Jersey

#### HS-008 954 Fld. 2/4

#### DEVELOPMENT OF A THREE CABLE GUIDE RAIL SYSTEM AND OTHER GUIDE RAIL TESTS, 1967-1968

by P. Smith

Ontario. Dept. of Highways, Downs-  
view (Canada), O13200

Mar 1970 41p  
Report no. RR-157

A series of impact tests of guide rail systems for rural highways confirmed that an effective post and cable system could be developed and that it would likely take the form of three half-inch steel cables mounted on 6-inch cedar posts spaced at 12-foot centers. A special provision would be required to facilitate cable tensioning and anchoring. The more costly alternative of heavy or light steel beams on similar posts did not prevent the test vehicles from leaving the road under the same conditions of impact. Preliminary tests on terminating devices or methods for steel beam guide rails and on strong beam design of aluminum medium barriers indicated the need for further development work.

Search terms: Guardrail design /Rural highways; Guardrail impact tests; Median barrier design

### 2/7 Meteorological Conditions

#### HS-008 955 Fld. 2/7; 1/3

#### HIGHWAY FOG

by Warren C. Kocmond; Keneth Per-  
chonok

Cornell Aeronautical Lab., Inc.,  
Buffalo, N. Y., C67200

1970 58p refs  
Report no. NCHRP-95

A literature review shows that fog results in a slight reduction in accident frequency, increases the likelihood that an accident will result in a fatality, and increases the likelihood that accidents will involve either a single vehicle or more than three vehicles. Traffic measurements indicated that speeds were slightly lower in fog, the probability of overdriving one's visual range was greatly increased, and lateral location and vehicle interactions were not affected. It is concluded that drivers are more cautious in fog but the increase in overdriving explains increased accident severity. Fog abatement methods are discussed, including seeding with hygroscopic material, vegetation barriers, use of helicopters to mix the air, and inhibition of evaporation from water reservoirs. Vehicle guidance in fog is discussed, including lights mounted near the road surface, polarized headlamps, and rear lighting.

Search terms: Fog /Accident rates; Fog /Accident severity; Fog /Multiple vehicle accidents; Fog /Fatalities; Fog /Single vehicle accidents; Fog /Speed patterns; Fog /Reduced visibility; Fog dispersal /Helicopters; Highway delineation lighting /Fog; Polarized headlamps /Fog; Rear Lamps /Fog; Vehicle guidance /Fog; Vegetation /Fog dispersal; Reservoirs /Evaporation; Weather modification /Fog; Cloud seeding /Salts; Cloud seeding /Fog; Fog /Reviews; Fog dispersal /State of the art studies

AVAILABILITY: HRB \$2.40

### 2/9 Traffic Control

#### HS-008 956 Fld. 2/9

#### THE EFFECTS OF INSTALLING NEW ZEBRA CROSSINGS IN RUGBY AND CHELMSFORD

by D. G. Wilson; S. J. Older

England. Road Research Lab., Crow-  
thorne, Berks., E14400

1970 28p  
Report no. RRL-LR-358

Some effects of doubling the number of zebra crossings in two towns are described. The proportion of all drivers stopping or slowing voluntarily for pedestrians on crossings showed no change in the experimental towns after the new crossings were installed. Vehicle journey time tended to be lower with pedestrian flows below about 400 peds/hour, and higher with pedestrian flows above this level, after crossings were installed. Pedestrian curb delay tended to be lower where vehicle flows were more than about 300 per hour after the crossings were installed. Pedestrians crossed the road more quickly with the crossings than without them. Pedestrian casualties were little changed in total by the introduction of the new crossings, but there were some inconsistent changes in the location of casualties in the towns studied.

Search terms: Zebra crossings /Pedestrian behavior; Zebra crossings /Pedestrian safety; Zebra crossings /Waiting time; Traffic flow /Zebra crossings; Accident rates /Pedestrian accidents; Driver behavior /Zebra crossings

AVAILABILITY: NTIS

#### HS-008 957 Fld. 2/9

#### AN INVESTIGATION OF THE DESIGN AND PERFORMANCE OF TRAFFIC CONTROL DEVICES

by J. Markowitz; C. W. Dietrich; W.  
John Lees; Melvin Farman

Bolt, Beranek and Newman, Inc.,  
Cambridge, Mass., B18000; Herman  
and Lees Associates, Inc., Cambridge,  
Mass., H08850

15 Dec 1968 347p 375 refs  
Contract CPR-11-5955  
Report no. PB-182 534; BBN-1726

A design and experimental study of  
traffic control devices, carried out by

multidisciplinary team of psychologists, engineers and graphic designers is described. The work encompasses an appreciation of the background and operation of uniform traffic control devices, an extensive series of laboratory investigations, road tests, and a substantive group of graphic design exercises. The investigation of the basic design elements of a transportation graphics system included the study of legend, pictograph, symbol, color, shape, arrows, and destination signing. Both the laboratory and the road experiment design and data analyses draw heavily on recent advances in the theory of signal detectability, an application of statistical decision theory. Applications of the study techniques to further problems are noted throughout. Also included is a graphic design discussion of the urban sign situation.

Search terms: Sign design/Multidisciplinary teams; Sign history; Sign shape; Sign color; Sign legibility; Sign recognition; Sign visibility; Sign design/Bibliographies; Traffic control devices/Design; Driving tasks; Driver behavior/Signs; Sign design/Graphic techniques; Signs/Data analysis; Signs/Road tests; Signs/Laboratory tests; Sign design/Psychological factors; Signs/Evaluation

AVAILABILITY: NTIS

HS-008 958 Fld. 2/9

#### TRAFFIC SIGNALS VISIBLE ONLY TO SELECTED DRIVERS

Published in *Public Works* v101 n1 p80-2 (Jan 1970)

Recently developed signal lights with the unique ability to channel their beams so they are visible only to the drivers who should see them are helping to solve difficult problems of traffic control in two Wisconsin cities. To drivers in "excluded" lanes, the signals appear not to be in use. The new signals can be beamed with an accuracy of plus or minus seven inches at 900 feet. The key element is a flat, incremental lens sealed in acrylic. This lens, in combination with a convex

glass element call the optical limiter, controls what the motorist sees and where he sees it. The decline in right-angle collisions since the advent of the optical signals is startling.

Search terms: Traffic signal visibility; Traffic signal brightness; Traffic signal effectiveness; Optical filters/Traffic signal controllers; Driver aid systems

HS-008 959 Fld. 2/9

#### ACCIDENT RISKS AT ZEBRA CROSSINGS

by M. H. Cameron

Australia, Road Research Board, Kew, Vic., A76800

1969 190p

Pedestrian accidents at zebra crossings are tabulated for the following variables: time of day; day of week; weather; road location; vehicle type; and presence of tramlines. Vehicle and pedestrian flow are graphed to provide information regarding exposure.

Search terms: Pedestrian accidents/Zebra crossings; Pedestrian injuries/Zebra crossings; Zebra crossings/Traffic flow; Zebra crossings/Accident statistics; Pedestrian accidents/Time of day; Pedestrian accidents/Day of week; Pedestrian accidents/Weather; Zebra crossings/Accident location; Tramways/Pedestrian accidents; Accident risks/Zebra crossings

HS-008 960 Fld. 2/9

#### DETECTOR LOCATIONS: AN ITE INFORMATIONAL REPORT

Anonymous

Published in *Traffic Engineering* v39 n5 p20-30 (Feb 1969)

This report concerns the location of permanent types of pedestrian and

vehicle detectors used for actuating traffic signal controllers and for obtaining certain traffic information. Pedestrian and vehicle detectors are described. Motion detectors for vehicles are used for traffic counting and measuring traffic speed and volume. Fourteen diagrams of both vehicle and pedestrian detectors are included.

Search terms: Pedestrian detectors/Traffic actuated traffic control; Vehicle detectors/Traffic actuated traffic control; Vehicle detectors/Traffic counters; Vehicle detectors/Speed sensors

HS-008 961 Fld. 2/9

#### SUE LES POSSIBILITES DE L'AUTOMATIQUE ET DE L'INFORMATIQUE DANS LA REGULATION DU TRAFIC ROUTIER (ON THE POSSIBILITIES OF AUTOMATION AND DATA PROCESSING FOR ROAD TRAFFIC CONTROL)

by L. De Brabander

Published in *Technical Aspects of Road Safety* n41 p2.1-10 (Mar 1970)

Text in French. Abstracts in French, English, Dutch, German.

The analysis of methods for gathering and distributing the information road-users need, clearly proves how automation and data processing can improve traffic flow. In this manner, the situation can be observed and interpreted, messages can be given to drivers and pedestrians, everything being done more thoroughly and, best of all, in less time. Attention is drawn to the importance of a good general organization of road safety and to the need for a searching analysis of objectives in order to ensure efficiency of the automatic devices.

Search terms: Traffic flow/Automatic control; Traffic flow analyzers; Traffic capacity/Automatic control; Sign recognition; Signs/Automation; Signs/Automatic control

## 3/0 HUMAN FACTORS

## 3/1 Alcohol

HS-008 962 Fld. 3/1

## ALCOHOL ABUSE AND THE BATON ROUGE APPROACH

by William Haddon, Jr.

Insurance Inst. for Highway Safety, Washington, D. C., I360000

Published in *Key Issues in Highway Loss Reduction*, Washington, 1970, P25-57

Presented at Insurance Institute for Highway Safety 1970 Symposium, Washington, D. C., 9-10 Jun 1970.

The role of drinking and alcoholism in the overall highway loss problem is discussed. The significance of various blood alcohol levels is explained and compared to accident involvement statistics. The city of Baton Rouge is using a mobile laboratory to test drivers for alcohol before arresting them. The constitutionality of this procedure has not yet been tested in the courts.

Search terms: Alcoholism / Accident factors; Drinking drivers / Accident factors; Driver intoxication / Accident factors; Alcohol breath tests / Baton Rouge; Alcohol breath tests / Constitutional law; Accident statistics / Blood alcohol levels

AVAILABILITY: In HS-008 943

HS-008 963 Fld. 3/1; 4/1

## PRE-ARREST BREATH TESTS

by Andrew R. Hricko

Insurance Inst. for Highway Safety, Washington, D. C., I360000

Published in *Key Issues in Highway Loss Reduction*, Washington, 1970, p59-64

Presented at Insurance Institute for

Highway Safety 1970 Symposium, Washington, D. C., 9-10 Jun 1970.

The constitutional issues raised by testing a driver for alcohol before arresting him are discussed. The procedure used in Great Britain is compared to implied consent laws in the United States. Court decisions of various states are discussed. The ordinance being used in Baton Rouge, permitting pre-arrest breath tests, is described.

Search terms: Implied consent laws; Alcohol breath tests / Baton Rouge; Alcohol breath tests / Constitutional law; Alcohol breath tests / Great Britain; Court decisions / Implied consent laws; Court decisions / Constitutional law; Arrests / Alcohol breath tests; Arrests / Drinking drivers

AVAILABILITY: In HS-008 943

HS-008 964 Fld. 3/1

## BATON ROUGE PROJECT: WHERE TO FROM HERE?

by Albert Benjamin Kelley

Insurance Inst. for Highway Safety, Washington, D. C., I360000

Published in *Key Issues in Highway Loss Reduction*, Washington, 1970, p65-70

Presented at Insurance Institute for Highway Safety 1970 Symposium, Washington, D. C., 9-10 Jun 1970.

The Baton Rouge project allows pre-arrest breath tests of suspected drunk drivers. It was set up to generate a court test of the constitutional issues involved and to test the usefulness of this type of law. No court test has yet taken place. Arrests are up, but it is too soon to evaluate results of the ordinance.

Search terms: Alcohol breath tests / Baton Rouge; Alcohol breath tests / Constitutional law; Arrests / Drinking drivers; Alcohol laws / Baton Rouge

AVAILABILITY: In HS-008 943

HS-008 965 Fld. 3/1; 1/3

## BLOOD ALCOHOL TESTING FOR MOTOR VEHICLE DEATHS. WISCONSIN. 1970

Wisconsin. Department of Social Services, Madison. Div. of Health, W19520

Feb 1971 23p

Reports for 1970 show that of 439 drivers and motorcyclists tested, 264 showed some alcohol content in the blood. Of the 264 decedents with alcohol in the blood, 233 had a blood alcohol level of 0.050 or more; 161 had a blood alcohol level of 0.150 or more. Statistics are given for sex, type of highway, age, time of day, day of week, and month of year. Wisconsin statutes for chemical tests of body tissue are included.

Search terms: Driver fatalities / Blood alcohol levels; Passenger fatalities / Blood alcohol levels; Pedestrian fatalities / Blood alcohol levels; Chemical analysis / Alcohol laws; Alcohol laws / Wisconsin; Fatalities / Males; Fatalities / Females; Fatalities / Accident location; Fatalities / Age factors; Fatalities / Time of day; Fatalities / Day of week; Fatalities / Month

HS-008 966 Fld. 3/1; 3/9

## LICENCE FOR MAYHEM

Published in *Public Health. The Journal of the Society of Medical Officers of Health* v83 n2 p57-62 (Jan 1969)

Alcohol as an accident cause is discussed. Lower blood alcohol level and severe penalty for drivers found to exceed limits is suggested. *Medical Fitness to Drive* published by the Medical Commission on Accident Prevention is reviewed. The report discusses physical fitness for driving, and lists such diseases as diabetes, epilepsy, and visual disorders as requiring evaluation for licensure to drive.

Search terms: Alcohol laws; Blood alcohol levels; Driver licensing / Driver physical fitness; Drinking drivers / Accident causes

MAY 21, 1971

## HUMAN FACTORS

HS-008 967 Fld. 3/1;3/11

### AAA SPECIAL SURVEY ON ALCOHOL TESTING AND PEDESTRIAN ACCIDENTS

Anonymous

Published in *Pedestrian Safety Report* v1 n2 p1-4 (Nov 1970)

A survey was made to determine the extent of involvement of alcohol in pedestrian accidents and the extent of use of chemical tests for determining pedestrian intoxication. Responses were received from 1,380 cities and towns. About half of the pedestrians killed are tested for alcohol. Pedestrians 35-44 years of age appear to be the major group showing alcohol involvement; pedestrians over 65 showed little alcohol involvement. Where tests were used for adult pedestrian fatalities, nearly 60% showed a blood alcohol content of 0.10% or higher. Most cities use more than one type of chemical test, most frequently blood and breath tests. The data are based on 1,062 adult pedestrian fatalities, of whom 487 were tested for blood alcohol content.

Search terms: Accident analysis /Pedestrian accidents; Pedestrian intoxication/Blood alcohol levels; Alcohol blood tests /Pedestrians; Pedestrian accidents /Fatalities; Pedestrian accidents /Age factor in accidents; Alcohol breath tests /Pedestrians; Alcohol chemical tests /Pedestrians

### 3/2 Anthropomorphic Data

HS-008 968 Fld. 3/2

### HUMAN IMPACT TOLERANCE. STATE-OF-THE-ART

by A. Wisner; J. Leroy; J. Bandet

Conservatoire National des Arts et Metiers, Paris (France), C63250; Organisme National de Securite Routiere (France), O20200

Published in *1970 International Automobile Safety Conference Compen-*

*dium* (P-30), New York, 1970, p783-96

56 refs

Report no. SAE-700399

Presented at 1970 International Automobile Safety Conference: Detroit, Mich., 13-15 May 1970, Brussels, Belgium, 8-11 Jun 1970.

A biomechanical model of the human body is needed and would be useful to auto engineers. The difficulties involved in determining human impact tolerance are discussed, such as limits of experimentation on man. The principal results of experiments and studies on injuries are reviewed, including head, spinal, thorax, abdominal, and lower limb injuries. Recommendations for injury prevention are made, including the use of energy absorbing devices, occupant protection, and restraint systems. Perspectives for further research are suggested.

Search terms: Impact tolerances /State of the art studies; Head injuries /Injury research; Spinal injuries /Injury research; Chest injuries /Injury research; Abdominal injuries /Injury research; Leg injuries /Injury research; Energy absorption; Occupant protection; Restraint systems; Biomechanics /Impact tolerances; Injury prevention

AVAILABILITY: SAE; also in HS-007 859

### 3/4 Driver Behavior

HS-008 969 Fld. 3/4

### CONCEPTUALIZATION OF OVERTAKING AND PASSING ON TWO-LANE RURAL ROADS. VOL. 1, SUMMARY REPORT

by Eugene Farber; Carl A. Silver; David H. Weir; Duane T. McRuer

Franklin Inst. Research Labs., Philadelphia, Pa., F24000; System Technology, Inc., Hawthorne, Calif., S63600

Dec 1967 43p 5 refs  
Contract CPR-11-2770  
Report no. TR-1-193-1; PB-183 698

Subcontracted to Systems Technology, Inc. Vol. 1 of 4.

A study to define the requirements of overtaking and passing maneuvers on two-lane roads in terms of both the judgmental and driver control processes is summarized. The goals and objectives of the program and their relation to the technical approaches adopted by the investigators are described. Conclusions and recommendations are presented and supporting research is summarized.

Search terms: Driver behavior /Passing; Driver behavior /Overtaking; Passing /Rural roads; Driver behavior /Decision making; Driver performance /Passing; Driver performance /Overtaking; Two lane roads /Passing; Driver behavior research

AVAILABILITY: NTIS

HS-008 970 Fld. 3/4

### CONCEPTUALIZATION OF OVERTAKING AND PASSING ON TWO-LANE RURAL ROADS. VOL. 2, DRIVER JUDGMENT

by Eugene Farber; Carl A. Silver

Franklin Inst. Research Labs., Philadelphia, Pa., F24000; Systems Technology, Inc., Hawthorne, Calif., S63600

Dec 1967 108p 7 refs  
Contract CPR-11-2270  
Report no. TR-1-193-2; PB-183 699

Subcontracted to Systems Technology, Inc. Vol. 2 of 4.

To obtain an understanding of the driver judgment problems associated with the pass - no-pass decision, eight empirical studies were conducted to determine the ability of drivers to judge and take into account the time, speed, and distance variables in a given passing opportunity. Seven of these studies were controlled experiments on a closed roadway; the eighth was a long-term observational study of passing practices on a rural highway. Results indicated drivers judged distance

**3/4 Driver Behavior (Cont'd.)****HS-008 970 (Cont'd.)**

variables adequately, but judged required passing time poorly. The latter was caused by inability to judge the speed of an oncoming car accurately. Drivers who were told the speed of oncoming cars, were able to use the information effectively in their passing performance. It was concluded that if such information were made available to drivers on the highway, their passing accuracy would increase, thereby improving safety and traffic flow. The study of methods for providing this information to drivers is recommended.

Search terms: Driver behavior/Passing; Driver behavior/Overtaking; Driver behavior research; Time factors/Passing; Speed/Passing; Distance/Passing; Driver behavior/Road tests; Passing/Rural roads; Oncoming vehicles/Speed; Passing aid systems; Driver behavior/Decision making; Passing/Two lane roads

AVAILABILITY: NTIS

**HS-008 971 Fld. 3/4****CONCEPTUALIZATION OF OVERTAKING AND PASSING ON TWO-LANE RURAL ROADS. VOL. 3, DRIVER CONTROL**

by David H. Weir; Duane T. McRuer

Franklin Inst. Research Labs., Philadelphia, Pa., F24000; Systems Technology, Inc., Hawthorne, Calif., S63600

Dec 1967 185p 39 refs  
Contract CPR-11-2770  
Report no. TR-1-193-3; PB-183 700

Subcontracted to Systems Technology, Inc. Previously announced as HS-002 459. Vol. 3 of 4.

A study was undertaken to determine why driver guidance and control errors occur, and how they can be avoided to reduce passing hazards. An operational model was developed for the driver-

vehicle-roadway system which uses feedback control theory. Some guidelines and recommendations resulting from application of the model are: driver cues should be considered in the design of roadway and nonmoving surround; disturbances of the driver/vehicle system should be minimized during overtaking and passing; small plants or other wind-moved objects along the roadway could alert the driver to gusty wind conditions; speed limits should be related to preview distance required for good control under adverse visibility conditions; drivers should be placed toward the front of the vehicle and relatively low to the ground; drivers should not hold the steering wheel at the bottom in disturbance conditions such as crosswinds; steering mechanisms should be designed to have good dynamic response characteristics for normal driver steering inputs.

Search terms: Driver performance/Vehicle control; Driver behavior/Passing; Driver behavior/Overtaking; Driver vehicle road interfaces/Mathematical models; Driver vehicle road interfaces/Mathematical analysis; Highway design/Driver road interface; Driver vehicle interface/Overtaking; Driver vehicle interface/Passing; Crosswind/Highway design; Driver vehicle road interfaces/Vehicle control; Speed limits/Visibility; Seat positioning/Vehicle control; Steering system design/Vehicle control; Vehicle control/Acceleration; Passing/Mathematical analysis; Crosswind/Vehicle control; Passing/Rural roads; Passing/Two lane roads; Driver behavior research

AVAILABILITY: NTIS

**HS-008 972 Fld. 3/4****CONCEPTUALIZATION OF OVERTAKING AND PASSING ON TWO-LANE RURAL ROADS. VOL. 4, INSTRUMENTATION**

by Warren Dunning; Bernard E. Epstein; Eugene Farber; Charles T. Davey; James D. Price; Carl A. Silver

Franklin Inst. Research Labs., Phila-

delphia, Pa., F24000; Systems Technology, Inc., Hawthorne, Calif., S63600

Dec 1967 53p  
Contract CPR-11-2770  
Report no. TR-1-193; PB-183 701

Subcontracted to Systems Technology, Inc. Vol. 4 of 4.

The instrumentation developed for the driver judgment and decision-making studies of this series is described in detail. Instrumentation used in the experimental studies included: sensors; transducers; speed, relative position, and dynamic parameter recording devices; magnetic loop detection system; photocell fifth wheel system; and stop watches. Variables recorded included: steering wheel, throttle, and brake pedal activity; heading rate; lateral and longitudinal acceleration; and lateral and longitudinal position. Instrumentation used in the observational studies were event recorders and stop watches. Parameters recorded included: pass -- no-pass action, vehicle speed, reaction time, passing time, and safety margin. Comments on the use and limitations of stop watches to record certain data, and a description of the eye-movement camera considered for these experiments are included.

Search terms: Driver behavior/Passing; Driver behavior/Overtaking; Road tests/Instrumentation; Instrumented vehicles/Passing; Vehicle positioning/Instrumentation; Passing/Instrumentation; Eye movements/Photographic equipment; Speed recorders; Passing/Rural roads; Passing/Two lane roads; Timing/Passing; Event rates/Recorders

AVAILABILITY: NTIS

**HS-008 973 Fld. 3/4****CONCEPTUALIZATION OF OVERTAKING AND PASSING ON TWO LANE RURAL ROADS. VOL. 4, INSTRUMENTATION**

by Warren Dunning; Bernard E. Epstein; Eugene Farber; Charles T. Davey; James D. Price; Carl A. Silver

Franklin Inst. Research Labs., Philadelphia, Pa., F24000; Systems Technology, Inc., Hawthorne, Calif., S63600

Mar 1969 28p  
Contract CPR-11-2770  
Report no. TR-1-193-Vol-4

Subcontracted to Systems Technology, Inc. Based on Vol. 4 of the final contract report, and reissued by Bureau of Public Roads, Vol. 4 of 4.

The instrumentation developed for the driver judgment and decision-making studies of this series is described in detail. Instrumentation used in the experimental studies included: sensors; transducers; speed, relative position, and dynamic parameter recording devices; magnetic loop detection system; photocell fifth wheel system; and stop watches. Variables recorded included: steering wheel, throttle, and brake pedal activity; heading rate; lateral and longitudinal acceleration, and lateral and longitudinal position. Instrumentation used in the observational studies were event recorders and stop watches. Parameters recorded included: pass — no-pass action, vehicle speed, reaction time, passing time, and safety margin. Comments on the use and limitations of stop watches to record certain data, and a description of the eye-movement camera considered for these experiments are included.

Search terms: Driver behavior/Passing; Driver behavior/Overtaking; Road tests/Instrumentation; Instrumented vehicles/Passing; Vehicle positioning/Instrumentation; Passing/Instrumentation; Eye movements/Photographic equipment; Speed recorders; Timing/Passing; Event rates/Recorders; Passing/Rural roads; Passing/Two lane roads

AVAILABILITY: NTIS

HS-008 974 Fld. 3/4

# CONCEPTUALIZATION OF OVERTAKING AND PASSING ON TWO LANE RURAL ROADS. VOL. 3, DRIVER CONTROL

by David H. Weir; Duane T. McRuer

Franklin Inst. Research Labs., Philadelphia, Pa., F24000; Systems Technology, Inc., Hawthorne, Calif., S63600

Mar 1969 92p 39refs  
Contract CPR-11-2770  
Report no. TR-1-193-Vol-3

Subcontracted to Systems Technology, Inc. Based on Vol. 3 of the final contract report, and reissued by Bureau of Public Roads, Vol. 3 of 4.

A study was undertaken to determine why driver guidance and control errors occur, and how they can be avoided to reduce passing hazards. An operational model was developed for the driver-vehicle-roadway system which used feedback control theory. Some guidelines and recommendations resulting from application of the model are: driver cues should be considered in the design of roadway and nonmoving surround; disturbances of the driver/vehicle system should be minimized during overtaking and passing; small plants or other wind-moved objects along the roadway could alert the driver to gusty wind conditions; speed limits should be related to preview distance required for good control under adverse visibility conditions; drivers should be placed toward the front of the vehicle and relatively low to the ground; drivers should not hold the steering wheel at the bottom in disturbance conditions such as crosswinds; steering mechanisms should be designed to have good dynamic response characteristics for normal driver steering inputs.

Search terms: Driver performance/Vehicle control; Driver behavior/Passing; Driver behavior/Overtaking; Driver behavior research; Driver vehicle road interfaces/Simulation models; Driver vehicle road interfaces/Mathematical analysis; Highway design/Driver road interface; Driver vehicle interface/Overtaking; Driver vehicle interface/Passing; Crosswind/Highway design; Driver vehicle road interfaces/Vehicle control; Speed limits/Visibility; Seat positioning/Vehicle control; Steering system design/Vehicle control; Vehicle control/Acceleration;

Passing/Mathematical analysis; Crosswind/Vehicle control; Passing/Rural roads; Passing/Two lane roads

AVAILABILITY: NTIS

HS-008 975 Fld. 3/4

# CONCEPTUALIZATION OF OVERTAKING AND PASSING ON TWO LANE RURAL ROADS. VOL. 2, DRIVER JUDGMENT AND DECISION-MAKING

by Eugene Farber; Carl A. Silver

Franklin Inst. Research Labs., Philadelphia, Pa., F24000; Systems Technology, Inc., Hawthorne, Calif., S63600

Mar 1969 51p 7 refs  
Contract CPR-11-2770  
Report no. TR-1-193-Vol-2

Subcontracted to Systems Technology, Inc. Volume 2 of 4. Based on Vol. 2 of the final contract report, and reissued by Bureau of Public Roads.

To obtain an understanding of the driver judgment problems associated with the pass — no-pass decision, eight empirical studies were conducted to determine the ability of drivers to judge and take into account the time, speed, and distance variables in a given passing opportunity. Seven of these studies were controlled experiments on a closed roadway; the eighth was a long-term observational study of passing practices on a rural highway. Results indicated drivers judged distance variables adequately, but judged required passing time poorly. The latter was caused by inability to judge the speed of an oncoming car accurately. Drivers who were told the speed of oncoming cars, were able to use the information effectively in their passing performance. It was concluded that if such information were made available to drivers on the highway, their passing accuracy would increase, thereby improving safety and traffic flow. The study of methods for providing this information to drivers is recommended.

**3/4 Driver Behavior (Cont'd.)****HS-008 975 (Cont'd.)**

Search terms: Driver behavior / Passing; Driver behavior / Overtaking; Driver behavior research; Time factors / Passing; Speed / Passing; Distance / Passing; Driver behavior / Road tests; Passing / Rural roads; Oncoming vehicles / Speed; Passing aid systems; Driver behavior / Decision making; Passing / Two lane roads

AVAILABILITY: NTIS

**HS-008 976 Fld. 3/4****CONCEPTUALIZATION OF OVERTAKING AND PASSING ON TWO LANE RURAL ROADS. VOL. 1, SUMMARY REPORT**

by Eugene Farber; Carl A. Silver; David H. Weir; Duane T. McRuer

Franklin Inst. Research Labs., Philadelphia, Pa., F240000; Systems Technology, Inc., Hawthorne, Calif., S636000

Mar 1969 20p  
Contract CPR-11-2770  
Report no. TR-1-193-Vol-1

Subcontracted to Systems Technology, Inc. Vol. 1 of 4. Based on Vol. 1 of the final contract report, and reissued by Bureau of Public Roads.

A study to define the requirements of overtaking and passing maneuvers on two-lane roads in terms of both the judgmental and driver control processes is summarized. The goals and objectives of the program and their relation to the technical approaches adopted by the investigators are described. Conclusions and recommendations are presented and supporting research is summarized.

Search terms: Driver behavior / Passing; Driver behavior / Overtaking; Passing / Rural roads; Driver behavior / Decision making; Driver performance / Passing; Driver performance / Overtaking; Two lane

roads / Passing; Driver behavior research

AVAILABILITY: NTIS

**HS-008 977 Fld. 3/4****PREDICTION OF DRIVING BEHAVIOR FOLLOWING A GROUP DRIVER IMPROVEMENT SESSION**

by Robin S. McBride

Published in *Journal of Applied Psychology* v54 n1 p45-50 (Feb 1970)

17 refs

A group of negligent drivers, requested by the California Department of Motor Vehicles to attend a driver improvement meeting, was administered a personality test and questionnaire. The purpose of the study was to determine the extent to which driving performance following the meeting could be predicted. The multiple regression results indicated that age, sex, S's "emotional" response to the meeting, and Gordon Personal Profile traits were significantly related to a 2-yr. subsequent driving record. The results suggest that the test battery has diagnostic and predictive potential for use in driver improvement programs.

Search terms: Driver improvement / Conferences; Driver improvement schools / Evaluation; Driver improvement measurement / Psychological tests; Driver performance / Forecasting; Negligent driver identification / Personality; Driver improvement / Regression analysis; Driver improvement / Group dynamics

**HS-008 978 Fld. 3/4; 2/9****FEEDBACK CONCEPTS OF DRIVER BEHAVIOR AND THE HIGHWAY INFORMATION SYSTEM**

by Henry S. Kao

Published in *Accident Analysis and Prevention* v1 p65-76 (1969)

80 refs

This paper represents an effort to conceptualize human factors in dynamic driving behavior and to discuss within a systems framework the possible use of multi-channel sensory input for highway information design. Most safety research in the past has suffered from a lack of theoretical orientation which led to the isolation of systems components for experimental manipulation and observation. The background for the systems concepts and analyses of driver performance presented here is a systems integration of findings in the neuropsychology of motion and perception, human tracking behavior, biocybernetics and communication science. The individual is considered as a closed-loop feedback control system which generates a course of action and corrects the consequences by means of sensory feedback information. Within this context, driving is viewed as a closed-loop, feedback-regulated driver-vehicle-road tracking system with well-organized signal, force, spatial, temporal, and motion properties. Highway information display is an integral part of this tracking system. Exploration of sensory modes other than vision, which are presently underutilized, could contribute to the improvement of highway information display and driver performance.

Search terms: Driver behavior research; Driver performance; Cybernetics / Driver vehicle road interfaces; Traffic information signs / Cybernetics; Traffic information signs / Perception; Traffic information signs / Motion perception; Traffic information signs / Neuropsychology; Traffic information signs / Visual perception; Traffic information signs / Auditory perception; Pavement markings / Visual perception; Vibration perception threshold

**HS-008 979 Fld. 3/4; 5/3****THE INVISIBLE MAN. PT. 2**

Anonymous

Published in *Air Force Driver* v2 n11 p10-5 (Apr 1969)

Motorcycle riding techniques for free-



ways and for curves are discussed. Additional pointers are provided by five cyclist-editors and one motorcycle policeman.

Search terms: Motorcycle riding techniques; Motorcycle safety

HS-008 980 3/4; 5/3

### THE INVISIBLE MAN. PT. 1

Anonymous

Published in *Air Force Driver* v2 n10 p14-7, 25 (Mar 1969)

The motorcyclist is presented as "invisible" and measures such as selective materials and color of clothing are suggested to improve his visibility. Other suggestions for safe operation of a motorcycle are given for braking the vehicle, and operation on city streets, open roads, and mountain riding.

Search terms: Motorcycle riding technique; Motorcycle visibility; Motorcycle safety; Motorcycle operators /Protective clothing

### 3/6 Driver Licensing

HS-008 981 Fld. 3/6

### DO COUNTERMEASURES WORK? FINDING OUT

by B. J. Campbell

North Carolina Univ., Chapel Hill. Highway Safety Research Center, N66000

Published in *Key Issues in Highway Loss Reduction*, Washington, 1970, p183-94

Presented at Insurance Institute for Highway Safety 1970 Symposium, Washington, D. C., 9-10 Jun 1970.

The theory that a small group of drivers accounts for most of the accidents is evaluated. Driver records in North Carolina do not bear out this

theory. Although people with medical handicaps have higher accident rates, only one in six such drivers can be expected to have an accident. Another common sense theory is that driver education should result in lower accident rates, but this cannot be proved. The whole process of driver licensing and testing needs to be evaluated.

Search terms: Driver education evaluation; Accident rates/Handicapped drivers; Accident rates/Driver education; Driver licensing/Evaluation; Driver tests/Evaluation; Driver records/North Carolina; Accident repeater drivers; Accident proneness

AVAILABILITY: In HS-008 943

HS-008 982 Fld. 3/6

### A STUDY OF PROCEDURES USED TO DETER DRIVE WHILE UNDER REVOCATION OR SUSPENSION

by William E. Timberlake

Northwestern Univ., Evanston, Ill. Traffic Inst., N74400

Feb 1970 75p

A study of ascertain the existence of programs to deter the use of motor vehicles by persons under suspension or revocation was conducted by means of a questionnaire. Responses did not reveal any singularly outstanding program. Motor vehicle administrators and police indicated shortcomings that either discourage action in enforcing suspensions or revocations, or prevent any action from being effective.

Search terms: Driver license revocation/Traffic law enforcement; Driver license suspension/Traffic law enforcement; Driver license revocation/Program evaluation; Driver license suspension/Program evaluation; Driver license revocation/Questionnaires; Driver license suspension/Questionnaires

HS-008 983 Fld. 3/6

### PERSONALITY CHARACTERISTICS OF JUVENILE DRIVING VIOLATORS

by Edward Levonian

Published in *Accident Analysis and Prevention* v1 p9-16 (1969)

22 refs

The purpose of the study was to determine whether personality is related to the driving violations of unselected juveniles when certain relevant factors were controlled. The sample consisted of 1080 driver education class members from each of 40 regular high schools. The variables included: five personality measures; number of vehicle code violations; driving experience per student's statement; and social area. Covariance analysis was used. The results emerge clearly: driver education students show a positive relation between number of violations and expediency even after control for four other personality measures as well as for sex, driving experience, and social area. The implications for the design of instructional materials and programs are set forth.

Search terms: Driver personality/Traffic law violations; Adolescent drivers/Traffic law violations; Variance analysis/Driver behavior research; Driver experience/Traffic law violations; Driver sex/Traffic law violations; Driver social class/Traffic law violations; Driver behavior research/Driver education; Traffic law violations/Driver education

### 3/7 Drugs Other Than Alcohol

HS-008 984 Fld. 3/7; 1/3

### MARIHUANA AND AUTOMOBILE CRASHES

by Arnold W. Klein; Joseph H. Davis  
Brian D. Blackbourne

Miami Univ., Coral Gables, Fla., M29100

1970 17p 5 refs

## OTHER SAFETY-RELATED AREAS

HSL No. 71-16

### 3/7 Drugs Other Than Alcohol (Cont'd.)

HS-008 984 (Cont'd.)

Presented at the Third Annual Meeting of the American Academy of Clinical Toxicology held in San Francisco, 26 Oct 1970.

Alcohol abuse constitutes the most serious chemical abuse problem on the highway; nevertheless increasing marijuana usage raises a question of a similar nature. Experienced marijuana smokers downgrade their abilities to drive except that the more chronic users claim less detrimental effect upon themselves. Road tests with drivers using high dosages of marijuana indicate dangerous effects on driving performance including a sensory illusion of roadway inversion.

Search terms: Marijuana/Driver performance; Marijuana/Vision disorders; Marijuana/Driver tests; Marijuana/Public opinion; Marijuana/Distance perception; Drugs; Marijuana/Perception

### 3/8 Environmental Effects

HS-008 985 Fld. 3/8; 5/11

#### MISS DRIVER'S WINTER TIPS

by Denise Roberts

Published in *The Air Force Driver* v4 n7 p6-8, 13 (Dec 1970)

Equipment and maintenance for winter driving are listed. Chains and studded tires are emphasized. Winter driving techniques are outlined.

Search terms: Winter driving; Winterization; Studded tires; Tire chains

### 3/11 Pedestrians

HS-008 986 Fld. 3/11; 3/12

#### ACTUAL PEDESTRIAN VISIBILITY AND THE PEDESTRIAN'S ESTI- MATE OF HIS OWN VISIBILITY

by Merrill J. Allen; Richard D. Hazlett;

Herman L. Tacker; Ben V. Graham

Published in *American Journal of Optometry and Archives of American Academy of Optometry* v47 n1 p44-9 (Jan 1970)

8 refs

Over 1,700 observations were made on the road involving actual pedestrians and cars, to test three factors of pedestrian visibility. Of 26 pedestrian observers, ages 18-35, the one pedestrian most pessimistic about his visibility closely estimated his true visibility of 175 feet. Each of the remaining 25 pedestrians estimated his visibility to be up to three times farther than it actually was. The average pedestrian thought he was visible at 343 feet. Actual pedestrian visibility was enhanced from about 175 feet for normal dark clothing to about 790 feet by using reflectorized clothing. In the presence of headlight glare, black clothing was seen at about 167 feet while the reflectorized clothing was seen at 680 feet. The clothing was reflectorized with a 1" fabric tape outlining the collar and wrapped around the sleeves. The reflectance of the tape was 50 candles/ft<sup>2</sup>/ft candle of incident light.

Search terms: Pedestrian visibility / Clothing; Reflecting materials / Pedestrian visibility; Pedestrian visibility / Color

### 3/12 Vision

HS-008 987 Fld. 3/12; 4/7

#### ASSESSMENT OF AUTOMOTIVE VISIBILITY BY A FIGURE OF MERIT

by Richard L. Barnoski; John R. Maurer; B. Andrew Kugler

Computer Sciences Corp., Los Angeles, Calif., C57350; Measurement Analysis Corp., Marina del Rey, Calif., M19500; Bolt, Beranek and Newman, Inc., Cambridge, Mass., B18000

Published in *1970 International Automobile Safety Conference Compendium* (P-30), New York, 1970, p644-76

14 refs

Report no. SAE-700394

Includes summaries in French and German. Presented at 1970 International Automobile Safety Conference: Detroit, Mich., 13-15 May 1970, Brussels, Belgium, 8-11 Jun 1970.

A mathematical model is presented to assess the direct visibility afforded a binocular driver of an auto. The model is structured to include a representation of the field of view available, as well as the visual field required for safe driving. The output of the model is a figure of merit. The range of the figure of merit for the thirteen 1969 vehicles tested is discussed. Such data provide relative measures of good visibility for the vehicles considered. The model, once refined and appropriately extended, can yield quantitative visibility standards for autos and in concept can be adapted to include trucks, buses, and visual aids such as rearview mirrors.

Search terms: Figure of merit / Mathematical models; Mathematical models / Visibility; Visual fields; Field of view; Visibility / Automobile models

AVAILABILITY: SAE; also in HS-007 859

## 4/0 OTHER SAFETY-RELATED AREAS

### 4/1 Codes and Laws

HS-008 988 Fld. 4/1

#### SOME NOVEL LEGAL ISSUES

by John F. Banzhaf 3rd

Action on Smoking and Health, Washington, D. C., A05000

Published in *Key Issues in Highway Loss Reduction*, Washington, 1970, p139-51

Presented at Insurance Institute for Highway Safety 1970 Symposium, Washington, D. C., 9-10 Jun 1970.

Legal remedies for dealing with the problems of highway loss are discussed. Actions against the automotive industry for negligence in manufacture and under implied warrant are suggested. Antitrust actions against the industry are also suggested. Other legal actions suggested are: development, proposal, and support of standards to the National Highway Safety Bureau; filing complaints with the Federal Trade Commission and Federal Communications Commission. The insurance industry is urged to play a role in this type of legal action.

Search terms: Highway safety / Legal factors; Automotive industry negligence; Automotive industry general attacks; Safety standards / Community support; Insurance industry / Highway safety; Federal role / Highway safety; Federal control / Automotive industry; Federal role / Legal factors

AVAILABILITY: In HS-008 943

#### 4/4 Governmental Aspects

HS-008 989 Fld. 4/4

#### HOW GOVERNMENT DOES -- AND DOESN'T -- WORK

by Albert Benjamin Kelley

Insurance Inst. for Highway Safety, Washington, D. C., 136000

Published in *Key Issues in Highway Loss Reduction*, Washington, 1970, p195-202

Presented at Insurance Institute for Highway Safety 1970 Symposium, Washington, D. C., 9-10 Jun 1970.

The purposes of the National Traffic and Motor Vehicle Safety Act of 1966 and the Highway Safety Act of 1966 are discussed. The powers and limitations of the National Highway Safety Bureau are described. The limitations in the two laws are discussed and applied to the example of bumper standards which would require bumpers able to withstand low speed impact. Authority to set such standards is lacking.

Search terms: National Traffic and

Motor Vehicle Safety Act of 1966; Highway Safety Act of 1966; National Highway Safety Bureau; Bumper standards; Bumpers / Impact tolerances

AVAILABILITY: In HS-008 943

#### 4/5 Information Technology

HS-008 990 Fld. 4/5

#### SOME POLICY OPTIONS

by William Haddon, Jr.

Insurance Inst. for Highway Safety, Washington, D. C., 136000

Published in *Key Issues in Highway Loss Reduction*, Washington, 1970, p203-13

Presented at Insurance Institute for Highway Safety 1970 Symposium, Washington, D. C., 9-10 Jun 1970.

A modern record system is needed which would incorporate in centrally retrievable form both some sort of identification number for each vehicle dealt with and a reliable source of information as to just what relevant characteristics each vehicle possessed at the time it was logged into the system. The lack of such a system prevents answering many of the most pressing vehicle-related policy questions regarding loss identification and reduction. Suggestions for such a system are outlined.

Search terms: Identification numbers; Automobile identification / Information systems; Vehicle characteristics / Information systems; Vehicle safety / Planning

AVAILABILITY: In HS-008 943

#### 4/8 Transportation Systems

HS-008 991 Fld. 4/8

#### STARK COUNTY AREA TRANSPORTATION STUDY. ANNUAL REPORT. 1969

Stark County. Area Transportation Study, Canton, Ohio, S39300

1970 27p

Four major work elements were completed in 1969: population-economics; land use; transportation facilities; and governmental control measures. Special projects include: municipal road funding; urban bottleneck five year plan; eligibility of Alliance for TOPICS; North Canton traffic plan; traffic counting program; federal grant for mass transit study.

Search terms: Transportation planning / Stark county; Transportation studies / Annual reports; Transportation planning / Federal aid; Public transportation / Federal aid; Traffic counts; Traffic Operations Program to Increase Capacity and Safety; Land usage / Transportation planning; Demography / Transportation planning; Economic factors / Transportation planning

#### 5/0 VEHICLE SAFETY

##### 5/4 Design

HS-008 992 Fld. 5/4

#### VEHICLE DESIGN LOSS FACTORS: THE CRASH TESTS OF 1970 MODELS

by John T. Holloway

Insurance Inst. for Highway Safety, Washington, D. C., 136000

Published in *Key Issues in Highway Loss Reduction*, Washington, 1970, p161-69

Presented at Insurance Institute for Highway Safety 1970 Symposium, Washington, D. C., 9-10 Jun 1970.

Low-speed crash tests of 1970 domestic models are described. The tests were made at 5 mph for both front and rear impacts; 10 mph for front impacts; 10 mph for front to rear impacts; and 10 mph for front into side impacts. Repair costs from these barrier tests are described.

Search terms: Automobile design /

# 5/4 Design (Cont'd.)

## HS-008 992 (Cont'd.)

Crashworthiness; Impact tests / Crashworthiness; Automobile repair costs / Barrier collision tests; Front end collisions / Automobile repair costs; Rear end collisions / Automobile repair costs; Side impact collisions / Automobile repair costs; Low speed impact tests / Automobile repair costs

AVAILABILITY: In HS-008 943

## HS-008 993 Fld. 5/4

### THE LOW SPEED CRASH TESTS — SOME SURPRISES

by John T. Holloway

Insurance Inst. for Highway Safety, Washington, D. C., 136000

Published in *Key Issues in Highway Loss Reduction*, Washington, 1970, p215-28

Presented at Insurance Institute for Highway Safety 1970 Symposium, Washington, D. C., 9-10 Jun 1970.

Three series of test results are described: 15 mph crashes into a barrier, 10 mph into a pole, and safety-related defects discovered during the crash tests. Repair costs of various automobile models involved in the tests are given.

Search terms: Automobile repair costs / Barrier collision tests; Vehicle fixed object collisions / Automobile repair costs; Automobile models / Automobile repair costs; Automobile defects; Low speed impact tests / Automobile repair costs

AVAILABILITY: In HS-008 943

## HS-008 994 Fld. 5/4

### A NEW GENERATION OF MULTI-GRADE "MS" OILS: LABORATORY AND FIELD PERFORMANCE

by R. L. Courtney; C. S. Roscoe

Chevron Research Co., Richmond, Calif., C37800; Standard Oil Co. (Ohio), Cleveland, S36600

1969 14p 30 refs  
Report no. SAE-690558

The "MS" multigrade oils of the "new generation" are identified by three characteristic features: higher viscosity index, superior viscosity retention, and performance exceeding minimum "MS" test requirements. Shear stability of the viscosity index improver is the most important property that directly affects oil economy. Shear stability can, in most cases, be evaluated in bench tests that correlate with vehicle tests. Excellent cylinder and ring wear benefits in both low and high temperature passenger car service can be obtained with polymer-thickened, high viscosity index oils. Passenger car on light duty truck service, such as stop and go or city traffic, have shown substantial savings in oil consumption with properly compounded SAE 10-W-40 oils.

Search terms: Lubricating oil tests; Manufacturing standards / Lubricating oils; Lubricant additives; Viscosity / Shear stability; Lubricating oils / Field tests; Lubricating oils / Laboratory tests; Lubricating oil tests / Taxicabs; Engine wear / Lubricating oils; Polymethacrylates / Lubrication; Polymers / Lubrication; Detergents / Lubrication; Lubricating oils / Costs

## HS-008 995 Fld. 5/4

### RECENT IMPROVEMENTS IN JAPANESE FARM AND INDUSTRIAL ENGINES

by Shigeo Nagasawa

Mitsubishi Heavy Industries Ltd., Tokyo (Japan)

1970 17p  
Report no. SAE-700693

Presented at Combined National Fair, Construction & Industrial Machinery and Powerplant Meetings, Milwaukee, Wis., 14-17 Sep 1970.

The improvements for our spark ignition and compression ignition engines are described. For the spark ignition engines the "CDI" system that was actually excellent in both startability and durability was developed; and for the compression ignition engines with the "DI" system, the possible zone of the hand start engine was drastically extended under cold temperature and the startability for the motor start engine has been also improved. The improvement of the startability has made the engine operational handling better. Moreover, when the startability had been improved, other advantages — output horsepower increase, engine weight reduction and noise reduction — were additionally attained because design restrictions were released.

Search terms: Ignition systems / Capacitance; Diesel engines / Starting; Cranking / Torque; Solid state devices / Ignition systems

AVAILABILITY: SAE

## 5/6 Fuel Systems

### HS-008 996 Fld. 5/6

#### KINETICS OF ENGINE-GENERATED NITROGEN OXIDES AND CARBON MONOXIDE

by Henry K. Newhall

Wisconsin Univ., Madison, W21600

Published in *Twelfth Symposium (International) on Combustion*, 1969, p603-13

46 refs

Reprint

During the expansion process in the internal combustion engine, the atomic species hydrogen and oxygen and the hydroxyl radical fail to recombine at rates sufficient to maintain shifting chemical equilibrium concentrations. The resulting persistence of excess atomic species and hydroxyl radicals, and the accompanying partial equilibrium established by the fast bimolecular reactions involving these species yields a ratio of hydrogen

atoms to hydroxyl radicals much greater than the ratio for total equilibrium. As a consequence, the partial equilibrium established by the fast bimolecular reaction between carbon monoxide and the hydroxyl radical inhibits oxidation of carbon monoxide. Nitric oxide is fixed throughout the expansion, the dominant bimolecular reactions, which involve nitrogen atoms and oxygen atoms, being too slow to promote appreciable nitric oxide destruction.

Search terms: Internal combustion engines/Nitrogen oxides; Internal combustion engines/Carbon monoxide; Internal combustion engines/Chemical reactions; Carbon monoxide/Hydroxyl radicals

HS-008 997 Fld. 5/6

#### ENGINEERING KNOW-HOW IN ENGINE DESIGN. PT. 18

Society of Automotive Engineers, Inc., New York, S21600

Jul 1970 61p  
Report no. SP-359

Presented at Milwaukee Section, Society of Automotive Engineers, 1969.

Five papers are presented on intake systems, exhaust systems, turbochargers, and mufflers. The influence of these components on the performance of internal combustion and diesel engines is described.

Search terms: Intake systems/Engine performance; Exhaust systems/Engine performance; Turbochargers/Engine performance; Mufflers/Engine performance; Internal combustion engines/Engine performance; Diesel engines/Engine performance; Engine design/Engine performance

AVAILABILITY: SAE

HS-008 998 Fld. 5/6

#### MATCH THE ENGINE INTAKE SYSTEM TO THE APPLICATION AND ENVIRONMENT

by David W. Morton

Donaldson Co., Inc., Minneapolis, Minn., D21500

Published in *Engineering Know-How in Engine Design, Pt. 18* (SP-359), New York, 1970, p1-8

8 refs  
Report no. SAE-700533

Engine air intake systems for construction, agricultural, and over-highway vehicles must remove a wide variety of contaminants. Good selection of components for the intake system depends on matching performance characteristics of the air cleaner and accessories to the expected types and concentrations of contaminants. Actual field dust concentrations and the relationship between field and laboratory service life are plotted for two-stage dry air cleaners in off-highway applications. These data, along with a summary of the major factors to consider in selection and layout of components, will aid in designing engine air intake systems.

Search terms: Air intake location; Intake systems/Engine design; Intake systems/Dust; Intake systems/Service life; Construction vehicles/Intake systems; Off the road vehicles/Intake systems; Farm vehicles/Intake systems; Intake systems/Contaminants

AVAILABILITY: SAE; also in HS-008 997

HS-008 999 Fld. 5/6

#### THE TURBOCHARGER - A VITAL PART OF THE ENGINE INTAKE AND EXHAUST SYSTEMS

by W. E. Woollenweber

Wallace-Murray Corp., New York, W01300

Published in *Engineering Know-How in Engine Design, Pt. 18* (SP-359), New York, 1970, p9-23

Report no. SAE-700534

The turbocharger is a component common to both the intake and exhaust systems of internal combustion engines. The manner in which it is applied can have a major effect on the performance and durability of the engine, as well as influencing the size and selection of other components in the system. A well-matched engine-turbocharger combination can be relatively insensitive to changes in environmental temperature and pressure, whereas a poorly matched combination may suffer extreme losses in performance and life. Some of the more important factors in matching a turbocharger to an engine are discussed with emphasis on how development of the turbocharger characteristics has contributed to engine performance.

Search terms: Turbochargers/Engine performance; Intake systems/Turbochargers; Exhaust systems/Turbochargers; Internal combustion engines/Turbochargers; Engine performance/Durability; Engine operating conditions/Pressure; Engine operating conditions/Temperature

AVAILABILITY: SAE; also in HS-008 997

HS-009 000 Fld. 5/6; 5/4

#### THE INFLUENCE OF INDUCTION AND EXHAUST SYSTEM DESIGN ON POWER PRODUCING CHARACTERISTICS OF DIESEL ENGINES

by Harold G. Holler

Caterpillar Tractor Co., Peoria, Ill., C33000

Published in *Engineering Know-How in Engine Design, Pt. 18* (SP-359), New York, 1970, p24-36

33 refs  
Report no. SAE-700535

Engine power production is proportional to weight of air trapped in the combustion chamber. This paper discusses how inlet system restriction, inlet air temperature, and exhaust back pressure influence engine per-

## 5/6 Fuel Systems (Cont'd.)

### HS-009 000 (cont'd.)

formance. A family of four cycle diesel engines from the naturally aspirated (90 bmep) to the turbocharged-aftercooled (220 bmep) is studied. System limitations are established, and future trends in engine design are discussed.

Search terms: Engine performance /Diesel engines; Exhaust systems /Diesel engines; Turbochargers /Diesel engines; Engine design /Diesel engines; Combustion chambers /Diesel engines; Intake systems /Diesel engines; Diesel engines /Power output; Engine design /Power output

AVAILABILITY: SAE; also in HS-008 997

### HS-009 001 Fld.5/6; 5/4

#### TURBOCHARGER AFTERCOOLING - WHY AND HOW

by Calvin J. King

Perflex Corp., Milwaukee, Wis., P13500

Published in *Engineering Know-How in Engine Design. Pt. 18* (SP-359), New York, 1970, p37-41

5 refs  
Report no. SAE-700536

Three types of water-cooled aftercoolers are now in use - the box type, the plug-in bundle type, and the in-head type. For stationary applications the box types are favored, while the in-head type is favored on vehicular applications because of its compactness. The in-head type aftercoolers, through improvements in specific heat transfer performance, are on the up trend. Further developments of air-to-air coolers, permitting lower intake manifold temperatures because of the lower temperature heat sink, are expected.

Search terms: Aftercoolers /Turbo-

chargers; Specific heat /Heat transfer; Intake manifolds /Aftercoolers; Engine performance /Aftercoolers; Intake systems /Temperature; Heat sinks /Intake manifolds

AVAILABILITY: SAE; also in HS-008 997

### HS-009 002 Fld. 5/6

#### MUFFLER SELECTION AND DESIGN FOR INTERNAL COMBUSTION ENGINES

by Dean G. Thomas

Nelson Muffler Corp., Stoughton, Wis., N36401

Published in *Engineering Know-How in Engine Design. Pt. 18* (SP-359), New York, 1970, p42-57

14 refs  
Report no. SAE-700537

In the selection of a muffler for the reduction of internal combustion engine exhaust noise, the acoustical problem is only one of many. Attention must also be given to problems of space availability and configuration. It is important that the best material for the purpose is chosen. Equally important is the most economic utilization of this material from the standpoints of original cost and availability and ease of production. Basic acoustical design and problems of fabrication and attachment are discussed. Special mufflers, including catalytic afterburners, are discussed in detail.

Search terms: Mufflers /Internal combustion engines; Exhaust noise /Internal combustion engines; Afterburners /Mufflers; Noise control /Exhaust noise; Catalysts /Afterburners; Acoustics /Mufflers

AVAILABILITY: SAE; also in HS-008 997

### HS-009 003 Fld. 5/6

#### NATURAL GAS FUELED VEHICLES EXHAUST EMISSIONS AND OPERATIONAL CHARACTERISTICS

by R. W. McJones; R. J. Corbeil

Pacific Lighting Service Co., P00400

1970 24p 8 refs  
Report no. SAE-700078

Presented at Automotive Engineering Congress, Detroit, Mich., 12-16 Jan 1970.

Natural gas fuel in a lean mixture with 25% excess air operates satisfactorily in an otherwise normal automotive engine. All exhaust emissions known to contribute to air pollution are reduced to levels meeting or bettering currently proposed standards. Dual-fuel operation with gasoline as a stand-by fuel permits immediate use of natural gas prior to the establishment of a widespread fueling network.

Search terms: Compressed natural gas /Fuels; Liquefied natural gas /Fuels; Engine modification /Natural gas; Natural gas /Exhaust emissions; Air fuel ratio /Natural gas; Natural gas /Emission tests; Natural gas /Air pollutants; Natural gas vehicles /Performance characteristics; Dual fuel vehicles; Natural gas /Fuel tanks; Air quality standards

AVAILABILITY: SAE

## 5/9 Inspection

### HS-009 004 Fld. 5/9

#### MANPOWER-MADE INSPECTION STATION FOR MOTOR-VEHICLES.

by Hisashi Kageyama; Tadayoshi Tsuchiya

Published in *Technical Aspects of Road Safety* n41 p3.1-14

Abstracts in French, English, Dutch, German.

The motor-vehicle inspection system in Japan is explained and reasons given for resorting to automatization of testing equipment, the main one being that the number of vehicles to be inspected grows faster than that of available inspectors. The automatized station described here is the one completed in 1969 in Kobe. It consists of

three buildings of which two are used for normal periodical inspections, whilst only new vehicles, undergoing their first inspection, have to pass through the third. Building no. 1 is intended for automatic testing of front brakes, speedometer, rear brakes and wheel alignment. The vehicle is driven by the applicant, who receives his instructions by means of signalling boards. Inspection results are automatically recorded and printed on a card issued at the end of each inspection lane. There are six of these and the total capacity of the station is 660 vehicles a day. Building no. 2 is organized and equipped for the remaining inspection tasks. The six lanes first pass over a large inspection pit for the examination of the underside of vehicles. After this comes the testing of lighting equipment and safety devices. The applicant-driver is given his instructions by various means and, here also, results are recorded and printed. Building no. 3 is used for additional operations in the case of a first inspection, when the vehicle has to be checked as to length, width, height, weight and the angle at which it overturns.

Search terms: Inspection stations / Japan; Inspection equipment / Automation; Inspection records / Automation; Inspection stations / Personnel; Vehicle inspection / Statistics

## 5/10 Lighting Systems

HS-009 005 Fld. 5/10

### THE LUCAS "AUTOSENSA"

by K. J. Jones; H. V. Hicks; Joseph Lucas

Published in *Technical Aspects of Road Safety* n41 p4.1-13 (Mar 1970)

Abstracts in French, English, Dutch, German.

The problem of seeing distance when one vehicle meets another is stated: existing lighting arrangements, in favourable circumstances, give a maximum seeing distance of 200 ft., which is inadequate. A theoretical approach and a theoretical solution for improve-

ment are described. The latter consists in having, to supplement the lower beams, another beam that is self-aiming in relation to an oncoming vehicle, in such a way that the oncoming driver receives no glare from it. In the practical solution, an automatic projector adjusts and aims its beam to suit prevailing traffic conditions. A double set of shutters, moving in unison, chop off parts of the beam, so that the eyes of oncoming drivers remain in shadow. This automatic projector is primarily intended for use on fast open roads and should be switched off in built-up areas. A few details are given concerning road tests made with this device, including a description of other road user's reactions.

Search terms: Autosensa; Low beamed headlamps / Oncoming vehicles; Headlamp aiming; Autosensa / Road tests; Automatic headlamp dimmers; Consumer attitudes / Automatic headlamp dimmers; Distance perception / Low beamed headlamps; Low beamed headlamps / Glare; Low beamed headlamps / Night visibility

HS-009 006 Fld. 5/10; 2/5

### PROSPECTS FOR IMPROVING VISION ON THE ROADS AT NIGHT

by R. L. Moore; A. W. Christie

England. Road Research Lab., Crowthorne, Berks., E14400

Published in *Police Research Bulletin* n13 (Jan 1970)

10p

Reprint

Street lighting and headlights are examined in relation to night visibility. With the advent of new Codes of Practice for street lighting and the use of brighter sources mounted on higher columns with better cut-off, more use is now made of diffuse reflection with less reliance on specular reflections. The glare which was such a prominent feature of older installations has been reduced by improved lantern design. Dipped beams and aim of headlamps are discussed. Several methods of aim

correction for changes in loading are listed.

Search terms: Night visibility / Street lighting; Night visibility / Headlamps; Headlamp aiming; Low beamed headlamps

## 5/11 Maintenance and Repairs

HS-009 007 Fld. 5/11; 3/4

### THE TOP THREE ENGINE KILLERS

by David N. Wenner

Published in *World Car Guide* n143 p44-7 (Jan 1970)

Engine failure occurs most frequently because of improper lubrication, faulty cooling system or its maintenance, and poor driver judgment as to the engine's operating limits.

Search terms: Automobile maintenance / Engine failures; Lubrication / Engine failures; Cooling systems / Engine failures; Antifreezes / Engine failures; Driver behavior / Engine failures

## 5/14 Occupant Protection

HS-009 008 Fld. 5/14

### ADDRESS

by Douglas W. Toms

National Highway Safety Bureau, Washington, D. C., N18000

Published in *Key Issues in Highway Loss Reduction*, Washington, 1970, p171-82

Presented at Insurance Institute for Highway Safety 1970 Symposium, Washington, D. C., 9-10 Jun 1970.

Occupant protection measures to prevent deaths from secondary collisions are discussed. Passive restraint systems, especially the air bag, are discussed from the point of view of managing the energy involved in deceleration. Tests of the air bag with baboons and human subjects are described. Engine deflection is another means of manag-

**5/14 Occupant Protection  
(Cont'd.)**

**HS-009 008 (Cont'd.)**

ing the energy of deceleration. The three priorities of the National Highway Safety Bureau are crash survivability, drinking driver control, and the experimental safety vehicle.

Search terms: Occupant protection/Secondary collisions; Passive restraint systems/Energy absorption; Air bag restraint systems/Energy absorption; Deceleration/Energy absorption; Engine deflection/Energy absorption; Accident survivability/Crashworthiness; Drinking drivers/Alcohol usage deterrents; Safety cars/Experimental automobiles; Priorities/National Highway Safety Bureau; Human deceleration tolerances; Animal deceleration tolerances/Baboons

AVAILABILITY: In HS-008 943

**HS-009 009 Fld. 5/14**

**THE STRUCTURE OF THE HUMAN BODY AS A LIMITING FACTOR TO SAFETY-BELT EFFICIENCY**

by F. van Faasen

Vrije Univ., Amsterdam (Netherlands), V20400

Published in *Conference on Road Safety. Vol. 1*, Brussels, 1968, pA6-1 to A6-4

Text in Dutch.

Grievances heard against the use of safety belts derive from the fact of the one-sided way they fix the human body so that the different parts of it are not uniformly decelerated. The analysis of the possible movements and the deformation of inner organs make it possible to establish, from the medical point of view, the advantages and disadvantages of each type of safety belt.

Search terms: Restraint systems/Deceleration; Restraint systems/Medical factors; Seat belt caused injuries/Biomechanics

**HS-009 010 Fld. 5/14**

**ASPECTS OF PASSENGER SAFETY**

by K. Burow; E. Fiala

Technische Univ., Berlin (West Germany), T08250

Published in *1970 International Automobile Safety Conference Compendium* (P-30), New York, 1970, p1000-7

Report no. SAE-700420

Includes summaries in French and German. Presented at 1970 International Automobile Safety Conference: Detroit, Mich., 13-15 May 1970, Brussels, Belgium, 8-11 Jun 1970.

The kinetic energy of a passenger during impact is studied on a model for car and passenger. The parameters are the car deformation, initial distance of passenger and car, active forces of the passenger, and safety devices. The initial distance between the passenger and the impact target is more important for the unrestrained passenger than for the supported passenger.

Search terms: Occupant protection/Impact phase; Occupant Kinematics/Mathematical models; Parameters/Occupant kinematics; Secondary collisions/Impact phase; Deceleration/Mathematical models; Deformation/Mathematical models; Impact tests/Simulation models; Barrier collisions/Simulation models; Restraint systems/Deceleration

AVAILABILITY: SAE; also in HS-007 859

**HS-009 011 Fld. 5/14; 1/2**

**INFORMATION ON INJURIES OBTAINED FROM REPORTS OF ACCIDENTS TO CAR OCCUPANTS WEARING SAFETY BELTS**

by G. Grime

University Coll., London (England). Research Group in Traffic Studies, U090000

Published in *Conference on Road Safety. Vol. 1*, Brussels, 1968, pA8-1 to A8-32

8 refs

An analysis of accident reports returned to a safety belt manufacturer showed that about two-thirds of the injuries to wearers of lap-and-diagonal belts were caused by striking parts of the car, and only one-third were due to restraining forces due to belts. Leg, knee, and arm injuries caused by impact with parts of the car were comparatively numerous and severe. Many leg and knee injuries are probably preventable by changes in the design of the car interior. Injuries due to the belt were mainly to shoulder, chest, ribs, and neck. Neck injuries were rarely serious. Automatic belts were more effective than ordinary lap-and-diagonal belts, particularly in preventing head injury to the driver.

Search terms: Three point restraint systems/Injury statistics; Seat belt caused injuries; Shoulder harnesses/Injury statistics; Head on collisions/Restraint system effectiveness; Single vehicle accidents/Restraint system effectiveness; Intersection collisions/Restraint system effectiveness; Rear end collisions/Restraint system effectiveness; Side impact collisions/Restraint system effectiveness; Three point restraint systems/Neck injuries; Three point restraint systems/Chest injuries; Three point restraint systems/Shoulder injuries; Restraint system effectiveness/Speed; Injuries by seat occupation

**5/18 Steering Control System**

**HS-009 012 Fld. 5/18**

**THE DETERMINATION OF THE "RIDE TRANSFER" CHARACTERISTIC FOR A STATIONARY, TRANSIENTLY EXCITED MOTOR VEHICLE**

by C. G. Watson

Girling Ltd., Birmingham, Warwick (England)



MAY 21, 1971

## NHTSA DOCUMENTS

1971 12p 18 refs  
Report no. SAE-710286

Presented at Automotive Engineering Congress, Detroit, Mich., 11-15 Jan 1971.

The transient excitation of a motor vehicle and subsequent Fourier analysis of the input and response transients, to obtain the ride transfer characteristic, is a valuable addition to vehicle laboratory vibration testing techniques used at present in the motor industry. It is a relatively inexpensive method for obtaining vibration results in the frequency domain, when compared with the usual techniques. Increasing the engine/transmission damping, from the inherent value of 0.05 critical to 0.43 critical using hydraulic dampers will increase the riding comfort by some 30-70% over the resonance range 10-20 Hz. This observation applies to a front engined (mounted fore/aft), rear wheel drive vehicle with values for its spring, damper mass, inertia, and position of center of gravity parameters as shown in Table 2.

Search terms: Vehicle riding qualities/Vibration tests; Vehicle riding qualities/Fourier analysis; Vehicle riding qualities/Damping

AVAILABILITY: SAE

## NHTSA DOCUMENTS

### NHTSA Accident Investigation Reports

HS-800 283 Fld. 5/11

### TABLES FOR MOTOR VEHICLE OWNER MAINTENANCE PRACTICES. PT. 1

Intext, Scranton, Pa., I45750

Apr 1970 495p  
Contract FH-11-6939

Addendum to HS-800 278.

Statistics on motor vehicle owner maintenance are divided into six chapters: national sample; year of car;

make of car; type of vehicle; age of respondent; sex of respondent. The questionnaire used in the national survey is included.

Search terms: Automobile maintenance/Statistics; Vehicle maintenance/Statistics; Questionnaires/Automobile maintenance; Automobile maintenance/Driver age; Automobile maintenance/Driver sex; Automobile maintenance/Automobile models; Automobile maintenance/Date of manufacture; Automobile maintenance/Vehicle age

AVAILABILITY: NTIS

HS-800 284 Fld. 5/11

### TABLES FOR MOTOR VEHICLE OWNER MAINTENANCE PRACTICES. PT. 2

Intext, Scranton, Pa., I45750

Apr 1970 586p  
Contract FH-11-6939

Addendum to HS-800 278.

Statistics on motor vehicle owner maintenance are divided into ten chapters: occupation of respondent; residence of respondent; schooling of respondent; motor vehicle inspection practices in different states; respondent knowledge of inspection; questionnaire data from the National Association of Fleet Administrators; driver data from this association; comparison of their data to the data gathered by the contractor; motorcycle data; and truck data. Some of the questionnaires used in the survey are included.

Search terms: Automobile maintenance/Statistics; Vehicle maintenance/Statistics; Questionnaires/Automobile maintenance; Questionnaires/Truck maintenance; Questionnaires/Motorcycle maintenance; Vehicle inspection/Statistics; Driver attitudes/Automobile maintenance; Driver educational levels/Automobile maintenance; Driver occupation/Automobile maintenance; Driver residence/

Automobile maintenance; Fleets/Vehicle maintenance

AVAILABILITY: NTIS

HS-800 374 Fld. 5/18

### VEHICLE HANDLING TEST PROCEDURES. FINAL REPORT. VOL. 1

by H. Dugoff; R. D. Ervin; L. Segel

Michigan Univ., Ann Arbor. Highway Safety Research Inst., M40800

Nov 1970 126p 17 refs  
Report no. FH-11-7297

A set of safety-relevant performance qualities was defined for the passenger car as a first step in the development of objective measures of precrash safety performance. Measures were sought that stress the performance produced by a passenger vehicle when it is operated under emergency, crash-avoidance conditions. This goal led to the identification of six limit maneuvers, and associated limit responses, to serve as a first-order means of assessing the safety quality of a motor vehicle. Two of the maneuvers involved control inputs so complex that a driver could not perform them with acceptable fidelity. These maneuvers accordingly were performed using an automatic control system to manipulate the steering, braking, and accelerator controls. The viability and discriminatory power of the proposed test procedures were demonstrated by applying these procedures to four separate vehicles reflecting widely different design philosophies and transport objectives.

Search terms: Vehicle handling/Automatic control; Vehicle handling/Servomechanisms; Vehicle handling/Test equipment; Vehicle handling/Accident avoidance; Vehicle handling/Emergencies; Braking; Turning; Steering; Lane changing; Fords/Vehicle handling; Toyotas/Vehicle handling; Corvairs/Vehicle handling; Mercedes/Vehicle handling; Vehicle safety performance/Highway safety

AVAILABILITY: NTIS

HS-800 375 Fld. 5/18

**VEHICLE HANDLING TEST PROCEDURES. FINAL REPORT. VOL. 2. SUMMARY**

by H. Dugoff; R. D. Ervin; L. Segal

Michigan Univ., Ann Arbor. Highway Safety Research Inst., M40800

Nov 1970 38p 5 refs  
Contract FH-11-7297

A set of safety-relevant performance qualities were defined for the passenger car as a first step in the development of objective measures of precrash safety performance. Measures were sought that stress the performance produced by a passenger vehicle when it is operated under emergency, crash-avoidance conditions. This goal led to the identification of six limit maneuvers, and associated limit responses, to serve as a first-order means of assessing the safety quality of a motor vehicle. Two of the maneuvers involved control inputs so complex that a driver could not perform them with acceptable fidelity. These maneuvers accordingly were performed using an automatic control system to manipulate the steering, braking, and accelerator controls. The viability and discriminatory power of the proposed test procedures were demonstrated by applying these procedures to four separate vehicles reflecting widely different design philosophies and transport objectives.

Search terms: Vehicle performance/Highway safety; Vehicle handling/Servomechanisms; Vehicle handling/Test equipment; Vehicle handling/Accident avoidance; Vehicle handling/Emergencies; Braking; Turning; Steering; Lane changing; Fords/Vehicle handling; Toyotas/Vehicle handling; Corvairs/Vehicle handling; Mercedes/Vehicle handling

AVAILABILITY: NTIS

HS-800 393 Fld. 5/14; 5/21

**APPLICATION OF RESTRAINT SYSTEMS TO USED CARS. FINAL REPORT. VOL. 1. SUMMARY**

by C. R. Ursell; G. J. Overby

Southwest Research Inst., San Antonio, Tex., S31800

Dec 1970 136p  
Contract FH-11-7306

The study of seat belt-shoulder belt anchorages for used cars is primarily directed toward those domestic passenger vehicles that are not provided with factory installed anchor points and/or have experienced some degree of deterioration. Other types of passenger vehicles such as compact and foreign are included in the study. The program consisted of field inspections to develop the criteria for used cars of the 1960-69 vintage from which the anchorage design was accomplished. The program actually resulted in two final anchors: the large area washer type and the rivnut type for blind attachment or installation access from only the inside of the passenger compartment. Lap and shoulder belt kits were developed and implemented using both types of end fittings. Seat belt load tests on salvaged vehicles resulted in a recommendation that a proof-load pull test is not as feasible as a compliance test because of the resulting damage to the owner's car. This report described sample kits which can be used to retrofit seat belts into used cars.

Search terms: Restraint systems/Used automobiles; Seat belt installation/Used automobiles; Seat belt assembly anchorages/Used automobiles; Compact automobiles/Restraint systems; Foreign automobiles/Restraint systems; Automobiles/Statistics; Used automobiles/Inspection; Automobile densities/Automobile models; Vehicle age/Automobile densities; Seat belts/Used automobiles; Shoulder harnesses/Used automobiles

AVAILABILITY: NTIS

HS-800 394 Fld. 5/14; 5/21

**APPLICATION OF RESTRAINT SYSTEMS TO USED CARS. FINAL REPORT. VOL. 2 EXHIBITS AND DRAWINGS**

by C. R. Ursell; G. J. Overby

Southwest Research Inst., San Antonio, Tex., S31800

Dec 1970 434p  
Contract FH-11-7307

This volume of the study of seat belt/shoulder belt anchorages for used cars contains individual exhibits and drawings referenced in Volume 1. Of primary interest are an exhibit containing the installation instructions for the belt kits recommended as a result of this study and an exhibit presenting inspection procedures that will lead to selection of suitable restraint kit.

Search terms: Restraint systems/Used automobiles; Seat belt assembly anchorages/Used automobiles; Restraint systems/Compact automobiles; Restraint systems/Foreign automobiles; Used automobiles/Inspection; Seat belts/Used automobiles; Shoulder harnesses/Used automobiles; Seat belt installation/Used automobiles

AVAILABILITY: NTIS

HS-800 400 Fld. 5/9

**MOBILE INSPECTION EQUIPMENT AND TECHNIQUES. VOL. 1. SUMMARY. FINAL REPORT**

by Howard C. Lawrence

RCA Service Co., Camden, N. J., R04600

30 Jun 1970 31p  
Contract FH-11-7291

Rept. for the period 20 Jun 1969-30 Jun 1970.

The state-of-the-art survey, the development, and the evaluation of a mobile motor vehicle safety inspection facility capable of performing a high quality periodic inspection are summarized. Conclusions given are: an effective mobile facility can be built and utilized; set up and repack time is compatible with frequent relocation; high quality inspection can be performed; suitable locations for an inspection lane are easily found; and

MAY 21, 1971

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public acceptance during the evaluation period was good.

Search terms: Mobile inspection stations/State of the art studies; Mobile inspection stations/Design; Mobile inspection stations/Evaluation

AVAILABILITY: NTIS

HS-800 401 Fld. 5/9

**MOBILE INSPECTION EQUIPMENT AND TECHNIQUES. VOL. 2. DETAILED REPORT. FINAL REPORT**

by Howard C. Lawrence

RCA Service Co., Camden, N. J., R04600

30 Jun 1970 186p 38 refs  
Contract FH-11-7291

Rept. for the period 20 Jun 1969-30 Jun 1970.

A study of available information concerning equipment, methods and procedures applicable to a mobile motor vehicle safety inspection facility was performed. A self-sufficient facility capable of providing a high quality safety inspection of passenger vehicles and small trucks was developed and evaluated under operational use. This facility consists of a Ford Type C-700 truck which carries a dynamic brake analyzer, a side slip type wheel alignment indicator, a pattern-photocell type headlamp tester, a powered front end lift, and required small tools and miscellaneous equipment. A trailer mounted electric generator supplies power. Hydraulically powered cargo handling equipment permits rapid unloading and loading. Those motorists whose vehicles were inspected by the facility endorsed it enthusiastically. Operators found the facility convenient to install and operate. A 16mm documentary movie, with sound, showing the operation of the facility has been prepared.

Search terms: Mobile inspection stations/State of the art studies; Vehicle inspection; Inspection stations; Inspection equipment;

Mobile inspection stations/Design; Inspection procedures; Mobile inspection stations/Power; Mobile inspection stations/Evaluation; Mobile inspection stations/Consumer acceptance; Diagnostic centers

AVAILABILITY: NTIS

HS-800 402 Fld. 5/9

**MOBILE INSPECTION EQUIPMENT AND TECHNIQUES. VOL. 3. OPERATING MANUAL. FINAL REPORT**

by Howard C. Lawrence

RCA Service Co., Camden, N. J., R04600

30 Jun 1970 113p  
Contract FH-11-7291

Rept. for the period 20 Jun 1969-30 Jun 1970

This manual details the operation of the mobile inspection facility, and may be used independently of volumes 1 and 2 of this study. It includes instructions for selection of an inspection site, unloading and loading of equipment, arrangement of equipment in a lane, and routine maintenance of equipment. Highlights of the maintenance required on the generator, truck, and brake analyzer, which should be carried out in accordance with manufacturers manuals, have been included for use in planning a facility operation. The inspector's manual used during evaluation of the facility is included. This manual covers only the most common items and deficiencies.

Search terms: Mobile inspection stations/Manuals; Mobile inspection stations/Location; Mobile inspection stations/Maintenance; Inspection procedures/Manuals; Inspection equipment/Reliability; Inspection equipment/Life expectancy

AVAILABILITY: NTIS

HS-800 405 Fld. 5/18; 4/7

**THE SKIDDING OF VEHICLES, A DYNAMIC ANALYSIS**

by Edward Saibel; Shang Li Chiang

Carnegie-Mellon Univ., Pittsburgh, Pa., C31200

Sep 1970 97p 10 refs  
Contract FH-11-6090

Subcontract CST-430.

A general model has been developed for finding vehicle response as a result of various acceleration or brake processes when it goes along a straight line. All important properties of vehicles have been included, such as center of gravity, moments and products of inertia of sprung mass, wheel mass, spring and damping constants of tires and suspension systems, wind effect, car dimensions, and tire size. The analysis leads to five non-linear second order ordinary differential equations. Computer programs are included. Output will predict velocity, acceleration, distance traveled, wheel deflections and deflection rates, suspension deflections and deflection rates, vertical tire forces, load distribution, and the point at which skidding begins.

Search terms: Skidding / Mathematical models; Vehicle stability/Mathematical analysis; Vehicle control/Mathematical analysis; Computer programs/Skidding; Vehicle center of gravity/Skidding; Inertial forces/Skidding; Tire forces/Skidding; Suspension systems/Skidding; Wind forces/Skidding; Vehicle size/Skidding; Wheel performance/Skidding; Tire sizes/Skidding; Equations/Skidding; Velocity/Skidding; Acceleration/Skidding; Deflection/Skidding; Loads (forces)/Skidding; Vehicle mass/Skidding; Dynamics/Skidding; Braking/Skidding

AVAILABILITY: NTIS

HS-800 422 Fld. 5/18

**EFFECTS OF STEERING AND SUSPENSION COMPONENT DEGRADATION ON AUTOMOBILE STABILITY AND CONTROL. PT. 1. SUMMARY REPORT**

**NHTSA Documents (Cont'd.)****HS-800 422(Cont'd.)**

by K. D. Bird; M. R. Belsdorf; R. S. Rice

Cornell Aeronautical Lab., Inc.,  
Buffalo, N. Y., C67200

Jan 1971 41p  
Contract FH-11-7384  
Report no. CAL-YC-2878-K-1

The objectives of this program were to determine, through vehicle testing, how various types of steering and suspension degradation affect objective measures of vehicle performance and to determine cost effective methods of inspection for these systems. The major results of four tasks are briefly described. A literature survey of over 150 related articles was made but uncovered little information of direct use. A test plan involving six vehicles and nine driving tasks was devised for investigating the influences of impairments of suspension and steering components on performance. Test results provided a firm foundation of quantitative measurements for evaluating these relationships. These results, together with supporting studies of the design and operation of components of interest in this program, were used as the basis for recommendation of cost-effective inspection requirements.

Search terms: Steering systems / Degradation failures; Suspension systems / Degradation failures; Suspension system inspection / Benefit cost analysis; Vehicle performance / Degradation failures; Vehicle control / Tests; Vehicle stability / Tests; Vehicle handling / Tests; Steering systems / Inspection costs; Steering systems / Inspection effectiveness; Driving tasks / Vehicle performance

AVAILABILITY: NTIS

**HS-800 423 Fld. 5/18**

**EFFECTS OF STEERING AND SUSPENSION COMPONENT DEGRADATION ON AUTOMOBILE STABILITY AND CONTROL. PT. 2. TECHNICAL REPORT. VOL. 1. LITERATURE REVIEW**

by R. D. Vergara

Cornell Aeronautical Lab., Inc.,  
Buffalo, N. Y., C67200

Jan 1971 83p 150 refs  
Contract FH-11-7384  
Report no. CAL-YC-2878-K-2

The objectives of this program were to determine, through vehicle testing, how various types of steering and suspension degradation affect objective measures of vehicle performance and to determine cost effective methods of inspection for these systems. This volume is concerned with a literature survey of related topics. Over 150 articles are reviewed. They cover vehicle performance, degradation of in-service components and system, current methods of inspection and diagnosis, life expectancy and failure data, and safety implications of degraded systems. Particular attention is given to earlier NHTSA-sponsored work in this general area.

Search terms: Steering systems / Degradation failures; Suspension systems / Degradation failures; Vehicle performance / Degradation failures; Suspension system inspection / Benefit cost analysis; Steering systems / Inspection procedures; Degradation failures / Vehicle safety; Degradation failures / Reviews; Degradation failures / Bibliographies; Steering systems / Reviews; Suspension Systems Reviews; Steering systems / Bibliographies; Suspension systems / Bibliographies; Steering systems / Inspection costs; Steering systems / Inspection effectiveness; Vehicle control / Degradation failures; Vehicle stability / Degradation failures

AVAILABILITY: NTIS

**HS-800 424 Fld. 5/18**

**EFFECTS OF STEERING AND SUSPENSION COMPONENT DEGRADATION ON AUTOMOBILE STABILITY AND CONTROL. PT. 2. TECHNICAL REPORT. VOL. 2. TEST PLAN**

by M. R. Belsdorf

Cornell Aeronautical Lab., Inc.,  
Buffalo, N. Y., C67200

Jan 1971 84p  
Contract FH-11-7384  
Report no. CAL-YC-2878-K-3

The objectives of this program were to determine, through vehicle testing, how various types of steering and suspension degradation affect objective measures of vehicle performance and to determine cost effective methods of inspection for these systems. This volume is concerned with test plan development. A test car complement covering a wide range of manufacturers, body and frame designs, and steering and suspension system layouts is described. Details of courses and procedures for nine driving tasks especially devised for the evaluation of the effects of component impairments on performance are given. Instrumentation requirements for these tests are outlined. The principle components which were investigated are identified and the quantitative levels of impairment which were used in the test program are described.

Search terms: Steering systems / Degradation failures; Suspension systems / Degradation failures; Vehicle performance / Degradation failures; Steering systems / Tests; Suspension systems / Tests; Steering systems / Test facilities; Suspension systems / Test facilities; Braking / Degradation failures; Cornering / Degradation failures; Icy road conditions / Degradation failures; Shock absorbers / Degradation failures; Ball joints / Degradation failures; Suspension systems / Alignment; Antiroll bars / Degradation failures; Steering systems / Instrumentation; Suspension systems / Instrumentation; Vehicle stability / Degradation failures; Vehicle control / Degradation failures

AVAILABILITY: NTIS

**HS-800 425 Fld. 5/18**

**EFFECTS OF STEERING AND SUSPENSION COMPONENT DEGRADATION ON AUTOMOBILE**

MAY 21, 1971

NHTSA DOCUMENTS

**STABILITY AND CONTROL. PT. 2.  
TECHNICAL REPORT. VOL. 3.  
TEST RESULTS**

by M. R. Belsdorf; R. S. Rice

Cornell Aeronautical Lab., Inc.,  
Buffalo, N. Y., C67200

Jan 1971 101p  
Contract FH-11-7384  
Report no. CAL-YC-2878-K-4

The objectives of this program were to determine, through vehicle testing, how various types of steering and suspension degradation affect objective measures of vehicle performance and to determine cost effective methods of inspection for these systems. This volume is concerned with test results. Some three thousand full-scale test runs were performed with selected combinations of test vehicle, driving task, type of impaired component, and degree of impairment. Results are given for the effects of degraded shock absorbers, ball joints, steering systems (free-play and misalignment), steering dampers, and roll bars on performance. Measurements are given in terms of both man-machine system behavior and control input requirements. It is shown that good discrimination among conditions can be achieved with the selected tasks.

Search terms: Shock absorbers / Degradation failures; Ball joints / Degradation failures; Steering systems / Degradation failures; Antiroll bars / Degradation failures; Degradation failures / Vehicle performance; Stabilizer bars; Suspension systems / Alignment; Wheel alignment / Tire wear; Vehicle road interface; Vehicle performance / Computerized test methods; Vehicle performance / Road tests; Vehicle performance / Laboratory tests; Vehicle stability / Degradation failures; Vehicle control / Degradation failures

AVAILABILITY: NTIS

HS-800 426 Fld. 5/18

**EFFECTS OF STEERING AND SUS-**

**PENSION COMPONENT DEGRADATION ON AUTOMOBILE STABILITY AND CONTROL. PT. 2. TECHNICAL REPORT. VOL. 4. INSPECTION REQUIREMENTS**

by R. S. Rice

Cornell Aeronautical Lab., Inc.,  
Buffalo, N. Y., C67200

Jan 1971 48p  
Contract FH-11-7384  
Report no. CAL-YC-2878-K-5

The objectives of this program were to determine, through vehicle testing, how various types of steering and suspension degradation affect objective measures of vehicle performance and to determine cost effective methods of inspection for these systems. This volume is concerned with inspection requirements. The results of a full-scale test program which produced quantitative measures of the component impairment-performance relationships and of examinations of actual hardware to identify the most likely courses of degradation are used to establish recommendations for cost-effective methods of inspection of steering and suspension systems. Current inspection techniques in general use are reviewed. These are used as reference points for recommendations on levels of acceptability in MVI.

Search terms: Steering systems / Degradation failures; Suspension systems / Degradation failures; Vehicle performance / Degradation failures; Suspension system inspection / Benefit cost analysis; Steering systems / Inspection costs; Steering systems / Inspection effectiveness; Inspection equipment / Costs; Shock absorbers / Inspection procedures; Ball joints / Inspection procedures; Steering systems / Inspection procedures; Alignment / Inspection procedures; Wheel alignment / Inspection procedures; Tire wear / Inspection procedures; Inspection standards; Vehicle stability / Degradation failures; Vehicle control / Degradation failures

AVAILABILITY: NTIS

HS-800 427 Fld. 5/18

**EFFECTS OF STEERING AND SUSPENSION COMPONENT DEGRADATION ON AUTOMOBILE STABILITY AND CONTROL. PT. 2. TECHNICAL REPORT. VOL. 5. APPENDICES**

by M. R. Belsdorf; R. S. Rice; R. D. Roland

Cornell Aeronautical Labs., Inc.,  
Buffalo, N. Y., C67200

Jan 1971 150p 9 refs  
Contract FH-11-7384  
Report no. CAL-YC-2878-K-6

The objectives of this program were to determine, through vehicle testing, how various types of steering and suspension degradation affect objective measures of vehicle performance and to determine cost effective methods of inspection for these systems. This volume contains background discussions on a variety of subjects with special significance to the program. Design features and operating characteristics of many examples of shock absorbers, ball joints, steering systems, rubber elements, suspension layouts, and alignment characteristics are described. Probable modes of degradation and failure are outlined in the frame work of identifying appropriate inspection procedures. A description of the digital computer simulation of an automobile used in support of the development of the test plan is given. Means for quantifying road holding capability are described.

Search terms: Steering systems / Degradation failures; Suspension systems / Degradation failures; Vehicle performance / Degradation failures; Suspension systems inspection / Benefit cost analysis; Steering systems / Inspection costs; Steering systems / Inspection effectiveness; Degradation failures / Inspection procedures; Digital computers / Inspection procedures; Ride simulators; Rubber / Degradation failures; Swing axles; Driving simulators; Vehicle road interface / Tests; Vehicle stability / Tests; Vehicle handling / Tests; Wheel alignment / Inspection procedures; Ball joints / Inspection

**NHTSA Documents (Cont'd.)**

**HS-800 427 (Cont'd.)**

procedures; Wheel alignment /Tire wear; Suspension systems /Struts; Power steering systems; Shock absorbers; Cornering; Vehicle control /Tests

AVAILABILITY: NTIS

**HS-800 459 Fld. 1/3**

**MULTIDISCIPLINARY STUDY OF VEHICLE ACCIDENTS IN NORTH CAROLINA. PHASE 1. FINAL REPORT**

by H. H. Hill; R. E. Kirk; F. C. Tyner

Research Triangle Inst., Durham, N. C., R08700

Dec 1970 160p  
Contract FH-11-7215

Results of 30 multidisciplinary accident investigations are presented in tables and graphs in addition to text for the following aspects: primary accident causes; accident classification; collision configuration; vehicle body style; environmental aspects including roadway; driver sex, race, mental and physical state, age, marital status, citations and license status, driving experience and training, familiarity with roadway, educational level and occupation; restraint system availability; vehicle damage and occupant injury scales; injury locations; and injury related to causative agent. Summaries of the 30 cases are included.

Search terms: Accident investigation /Multidisciplinary teams; Accident causes; Accident types; Models /Accident statistics; Body types /Accident statistics; Environmental factors /Accident statistics; Highway characteristics /Accident statistics; Driver characteristics /Accident statistics; Restraint systems /Accident statistics; Damage severity index /Accident statistics; Injury severity index /Accident statistics; Injury causes /Accident statistics; Accident statistics /Graphs

AVAILABILITY: NTIS

**HS-800 464 Fld. 4/2; 2/0**

**COMMUNITY ACTION PROGRAM FOR TRAFFIC SAFETY. GUIDE 7. PUBLIC SUPPORT**

by Mel D. Powell; Michael K. Gemmell; Donald Murray; Warren P. Howe

National Assoc. of Counties Research Foundation, Washington, D. C., N06600

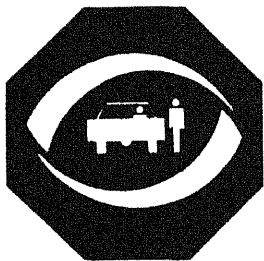
Sep 1970 20p  
Contract FH-11-7091

Previous guides were announced under the following HS numbers: Guide 1, HS-800 309; Guide 2, HS-800 318; Guide 3, HS-800 365; Guide 4, HS-800 366; Guide 5, HS-800 406.

This guide will discuss some of the basic principles of an effective traffic safety support program, placing emphasis on the techniques by which public support may be achieved, and including the various stages of its development. By analyzing each step in its logical sequence, this guide seeks to assist local officials in discerning the important role they can play in developing local traffic safety support programs. A clear perception of the process should enable local officials to make more efficient use of their limited resources. It should also help them to more clearly recognize the interrelationships that exist between public support and the various administrative responsibilities inherent in a comprehensive, community-wide traffic safety and highway loss reduction program. Before delving into the process of developing support, this guide explores some of the basic problems that have plagued past attempts at encouraging citizen action.

Search terms: Community support /Local government; Community support /Highway safety programs; Associations /Highway safety programs; Industries /Highway safety programs; Public relations /Highway safety programs; Universities /Highway safety programs; Public information programs /Highway safety; Mass media /Highway safety programs

AVAILABILITY: NTIS



# executive summary

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## A SYNOPSIS OF A RECENTLY RELEASED NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION RESEARCH REPORT

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### IMPROVING THE ENFORCEMENT OF DRIVER LICENSE DENIALS, SUSPENSIONS, AND REVOCATIONS

The purpose for which this contract was awarded was to identify and propose effective methods for improved enforcement of denials and to identify needed programs of research to develop improved techniques for enforcement.

Contract No. FH-11-7283  
Exotech Systems, Inc.  
525 School Street, S.W.  
Washington, D. C. 20024

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DOT/HS-800 322      Part 1: Preliminary Guidelines PB-195 811  
DOT/HS-800 323      Part 2: Technical Report PB-195 812

#### FORWARD

The term "denial" as employed in this synopsis and throughout the report, includes withdrawals, suspensions, revocations, and cancellations of driver licenses.

Part one of the report presents a summary of the recommendations of a study on the improvement of the enforcement of driver license denials. Part two presents a more detailed discussion of the findings, analysis, and recommendations. The report complements two other studies concerning license denials: The National Committee on Uniform Traffic Laws and Ordinances' published summary of state penalties for driving after revocation or during a suspension and, Northwestern University Traffic Institute's published survey of enforcement methods employed by police and motor vehicle agencies. In the study conducted by Exotech, a systems approach was taken toward the mechanism of imposing and enforcing denials, and advanced technology was investigated, to

identify the most promising ways to improve denial enforcement.

#### BACKGROUND

Through research, review of pertinent literature and reports, and interviews, methods to administer and enforce license denials and the problems associated with various measures were studied. The conclusions and recommendations are based on the analyses of findings from the survey and research.

The report is written with a view toward the national scale of the denial enforcement problem and the means to deal with it. With nearly 40,000 jurisdictions in the United States, specificity at the community level is avoided. The institutions and policies for the administration and enforcement of license denials have been considered using a systems approach: functions performed by agencies and their relationships have been examined as elements of a system; objectives and their resource implications are considered; and a broad and comprehensive

view of the whole is taken rather than a microscopic examination made of a part.

The study did not consider questions concerning the validity of the concept of license withdrawals or to specifically examine ways of influencing driver attitudes toward denial actions. Driver licensing and denial functions, as well as associated behavioral issues and approaches, are discussed in a 1969 Spindletop study. Recommendations made for the detection and enforcement of denials are purely conditional: if denials should be enforced, then the recommendations apply.

#### MAJOR FINDINGS, RESULTS AND RECOMMENDATIONS

Improvements in the enforcement of denials can be brought about by a combination of several actions: application of management principles; commitment of objectives, commitment to enforce mandatory statutes; public accountability; reducing ease of denial violation; improving incentives to comply with denials; integration of communications and data requirements for denial policing with criminal information systems; creation of special files for denial operators accessible through the criminal information system by registration or license data; driver surveillance using data transmission technology.

The number of denials in force is roughly 1.5 percent of the total licenses in force. About 3 million denial actions are taken annually: 1/3 for financial responsibility, 1/3 for points, 1/3 for driving while intoxicated, reckless driving, and other serious offenses. About 0.15 percent of drivers are convicted for violating a denial. About 10 percent of driver whose license was ever withdrawn have at some time received at least one more denial. (Values are for the United States and Canada.)

About 160,000 man-years of police effort are devoted to performing traffic-related functions; roughly half of the effort, i.e., 160,000,000 manhours/year, is spent on patrol duty. This activity produces roughly 300 to 500 million

driver contacts per year including 100 million citations and 10 million accidents. The volume of checking of driver records for law enforcement purposes is probably between 1 million and 10 million per year.

The process by which denials are applied and enforced is generally not managed systematically. The different agencies which have responsibilities for denial administration, policing, and enforcement generally have neither common goals nor common factual information concerning denials. Agencies also have other responsibilities or preferences which conflict with denial enforcement or have higher priority. Existing opportunities for limiting denial violations are generally not utilized by agencies whose mission is not seen to include denial management functions.

The low visibility of specific references to the policing of denials, checking of records of drivers cited for traffic offenses, and related procedures, is particularly noticeable in most of the literature concerning traffic law enforcement. Published research on the relation of violating denials to traffic injury generation, on the incidence of denial violations, and on the relation of denial violations to driving while intoxicated, is lacking. The effectiveness of court enforcement actions has not been measured. Compliance, recidivism, deterrence, and rehabilitation are topics with scanty knowledge but much conjecture.

Denial violations do not have a very high status value in some criminal justice agencies. Career incentives of police, and positions of license denials taken by courts can work against effective denial policing and enforcement.

Denials are imposed for offenses that differ widely in risk to life and property but are officially considered equal for policing and enforcement purposes. The standard summary accident report makes no provision for noting the status of licenses of drivers in accidents. Denial violations are defined as not hazardous and are not defined as serious traffic offenses. Driving while suspended is not considered acci-



dent causative for selective enforcement planning purposes.

Measures of the hazard represented by denial violators are not available. Only one study could be obtained that contained data on denials of drivers killed in accidents: 53 percent of the drivers at fault had been drinking; 4 percent of the drivers at fault were violating a denial. Most of the data necessary to measure the hazard were collected for other purposes and are in agencies' records.

Patterns of motor vehicle ownership and usage which meet society's economic needs make license denials, unreliable driver controls: violations are difficult to prevent, transportation alternatives are rare. Denial violations are deliberate acts; that they are risks taken for some other purpose tends to be viewed ex post as a rationale not to enforce mandatory statutes, rather than ex ante as a challenge to find ways of improving voluntary compliance.

Every successful violation reinforces the expectation to be successful again; if denials are to be effective, they must be credible, i.e., the chance of getting away with a violation without being caught must be as small as possible. Violations can only be determined from an official record; checking driver license status to detect denial violations is therefore a critical requirement. Driver license records are now checked in only about 1/80 to 1/20 of all traffic citations; among the main reasons for this small ratio are communications and records limitations.

A second critical requirement not now being fulfilled is that a detected violation will have predictable, prompt, and practical consequences. We suggest that this consequence should be the mandatory confiscation of the registration plate and certificate of a vehicle - not of the car itself - whose driver is apprehended while violating a denial. To be predictable, the confiscation must be mandatory; to be prompt, it must be part of the arrest or citation procedure; to be practical, it should have an operational effect which reinforces the denial - "you are not to drive" - without interfering with property rights.

The management and enforcement of denials requires a clearly stated statewide or community-wide policy, set of realistic objectives which are supported by all of the agencies whose participation is required, a plan of action to accomplish the objectives, an organized term approach with timely and appropriate information for all members of the team, formal commitment by the team members to the plan of work, systematic evaluation of effectiveness, and public accountability for results.

The denial enforcement tasks which are required of the criminal justice agencies, e.g., police and courts, must be fully compatible with their responsibilities to control crimes against persons, crimes against property, organized crime, and civil disorder.

Planning should include an examination of the fiscal incentives reflected in the statutes under which denials are administered. Problems or conflicting priorities regarding costs borne and benefits and revenues received by different jurisdictions should be identified and resolved. Planning should include agencies whose statutory or administrative powers allow them to contribute - directly or indirectly - to the denial management, policing, and enforcement program even if their primary mission responsibilities do not include such functions.

The acceptable levels of risk to the community which are presented by drivers should be determined; and the changes in risks to be accomplished by application of resources to the administrations and enforcement of denials should be determined. Specific actions, e.g., detection of a denial violation, apprehension of the violator, prosecution, adjudication, and enforcement of statutory sanctions, deal with individuals; planning, analysis, and evaluation, however, must necessarily deal with aggregate measures of risk, just as the formulation of the community objectives for denial management and enforcement represent risk levels.

Statistical measures for planning and evaluation can be obtained without undue difficulty if

they are provided for in the operational procedures and forms.

In view of the scarcity of analytical resources in most agencies and jurisdictions, consideration should be given to organizing them on a statewide or community-wide task team basis to avoid duplication, improve accessibility and utilization of quantitative information, assure consistency of methods and assumptions, and provide technical assistance to smaller communities in their efforts. An agency with statewide responsibility, authority, and resources including data can best support and lead a statewide effort.

Recommendations cover topics with varying expected contributions to increase compliance. No one action by itself will accomplish everything, nor is any recommendation designed to accomplish the impossible, namely, to prevent 100 percent of the denied operators from driving 100 percent of the time of their denial. Several recommendations are meant to eliminate loopholes and contribute to a climate of official watchfulness.

Results of this study can be applied to states or local communities only after an evaluation of their own conditions, needs, and resources. It is recommended that such evaluations be made explicitly. Many suggested improvements will already have been considered or implemented by a community; in many instances, the part of the denial compliance problem which the recommendation is intended to affect, does not exist due to policy, law, or procedure.

The Contract Manager has certified that the contractor's work has been satisfactorily completed and that all contractual obligations have been met on this phase of the contract.

The opinions, findings, and conclusions expressed in this summary are those of the contractor and not necessarily those of NHTSA.

Availability: NTIS (Formerly Clearinghouse - CFSTI), U.S. Department of Commerce, Springfield, Va. 22151. Order DOT/HS-800 322 for Part 1 and DOT/HS-800 323 for Part 2 in paper copy (PC), \$3.00 per vol. or microfiche \$.95. Make check or money order payable to NTIS.



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